

CDB Part IB

Plant Development

Lecture 1

Plant embryogenesis and establishment of the body plan

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Plant Development

Lecture 1: Plant embryogenesis and establishment of the body plan.

Lecture 2: Polarity, auxin traffic and auxin response.

Lecture 3: Regulation of root initiation and growth by auxin.

Lecture 4: Patterning of shoot growth.

Web resources:

An electronic version of the lecture slides, a colour version of these notes and additional teaching materials including review papers and essay topics can be found on the web site: <http://haseloff.plantsci.cam.ac.uk> (click the “education” menu choice and navigate to the CDB Part 1B resources section).

Recommended Text books:

For an integrated overview of animal and plant development see:

***Principles of Development*, Lewis Wolpert and Cheryll Tickle, Oxford University Press, 2011.**

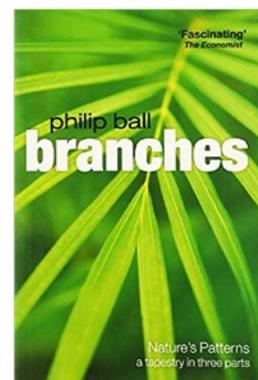
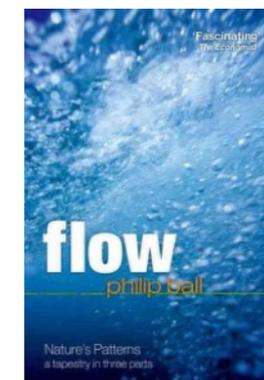
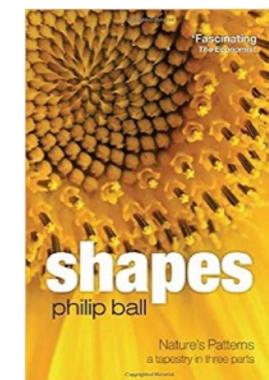
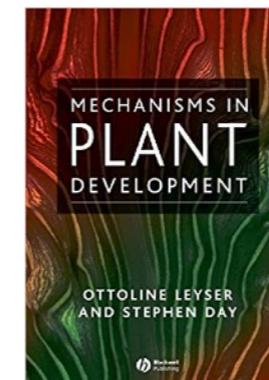
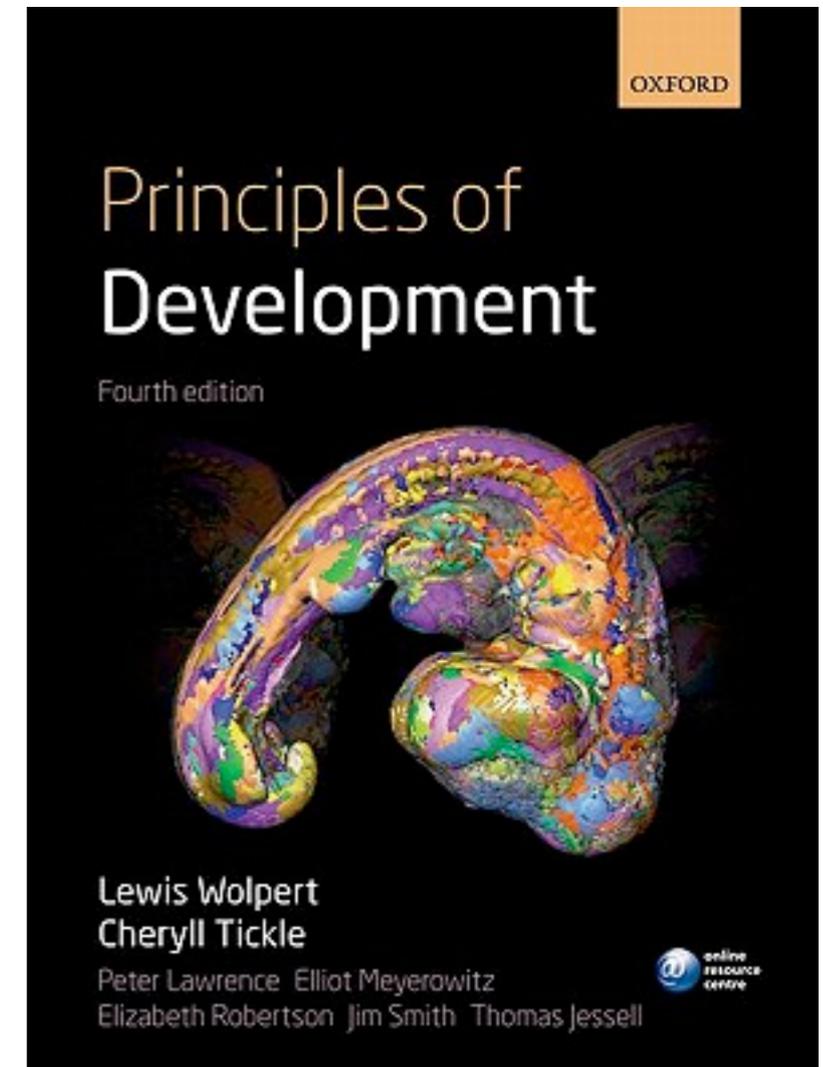
Chapter 7 provides a concise overview of the lecture content.

For coverage of plant development see:

***Mechanisms in Plant Development*, Ottoline Leyser & Stephen Day, Blackwell Science, UK, 2002.**

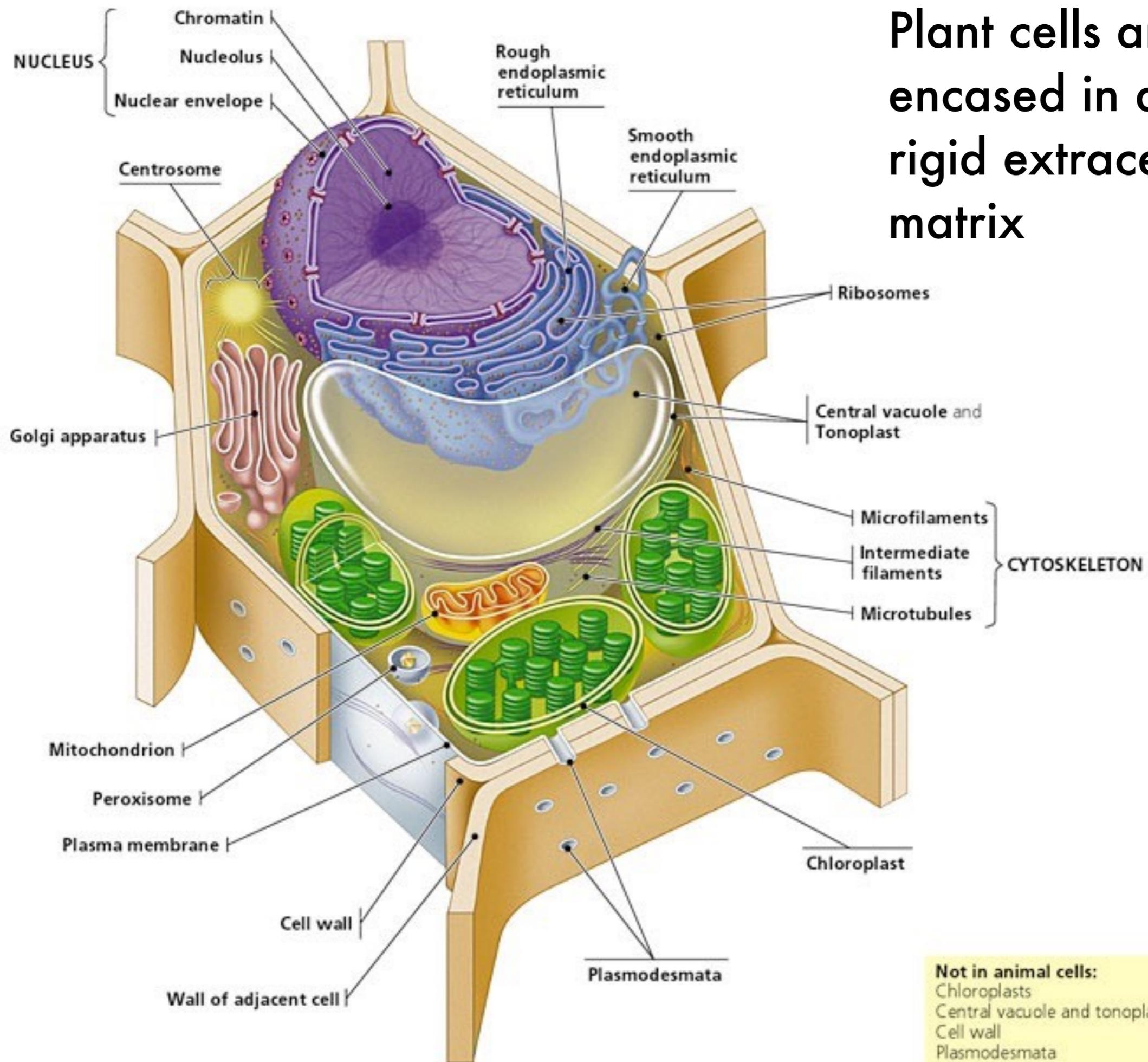
For a general discussion of self-organisation across physical and biological systems see:

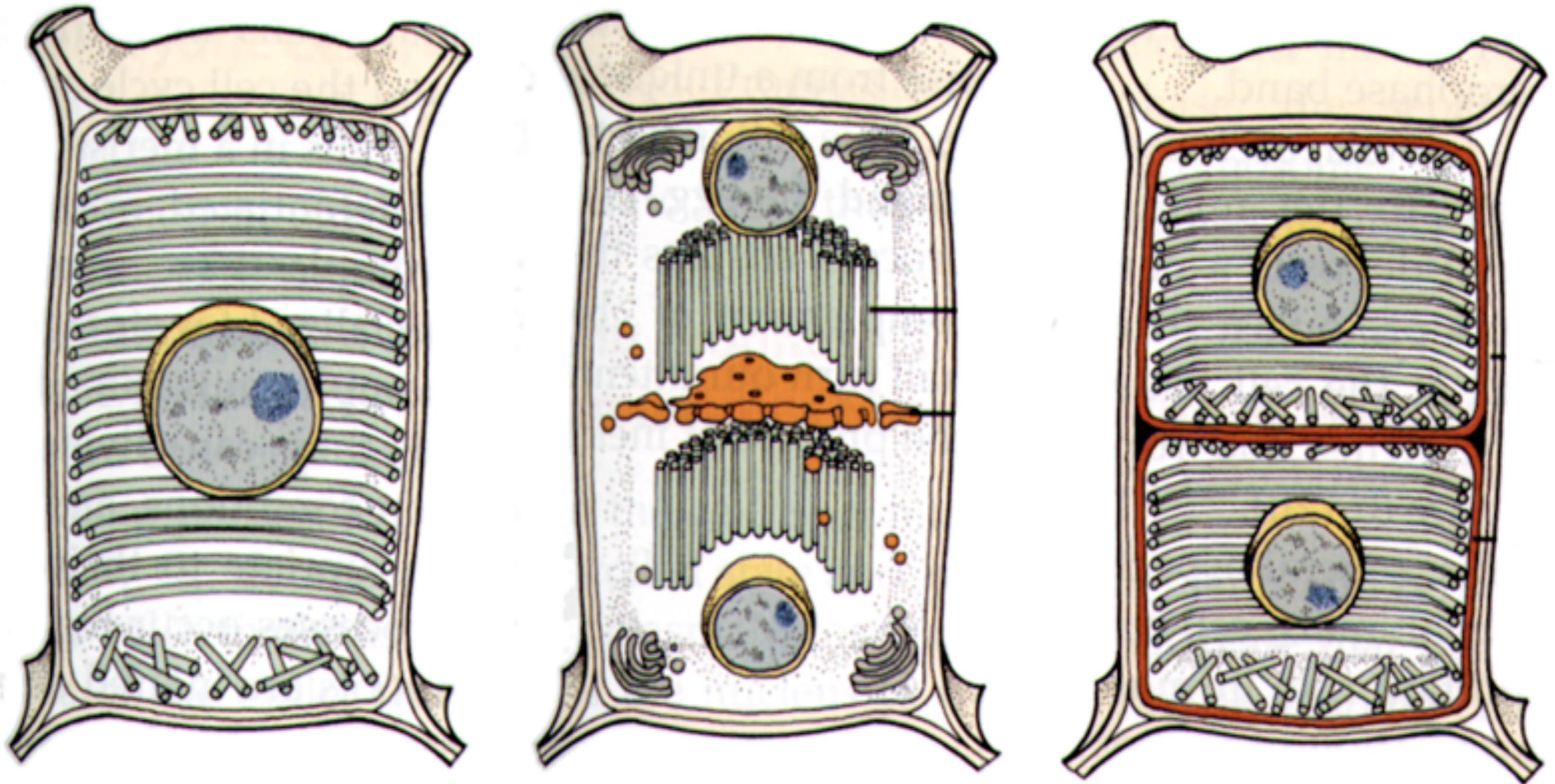
***Nature's patterns: a tapestry in three parts, Shapes, Flow and Branches*, Phillip Ball, Oxford University Press, 2009.**





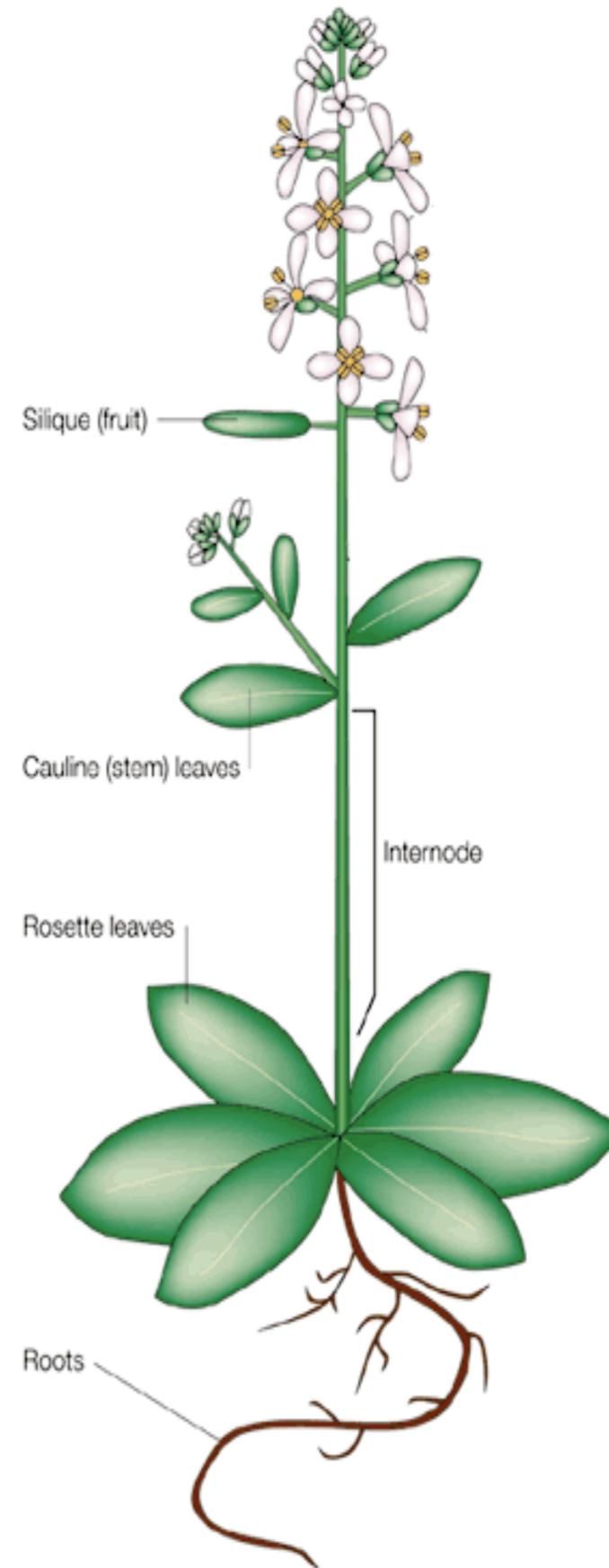
Plant cells are encased in a semi-rigid extracellular matrix

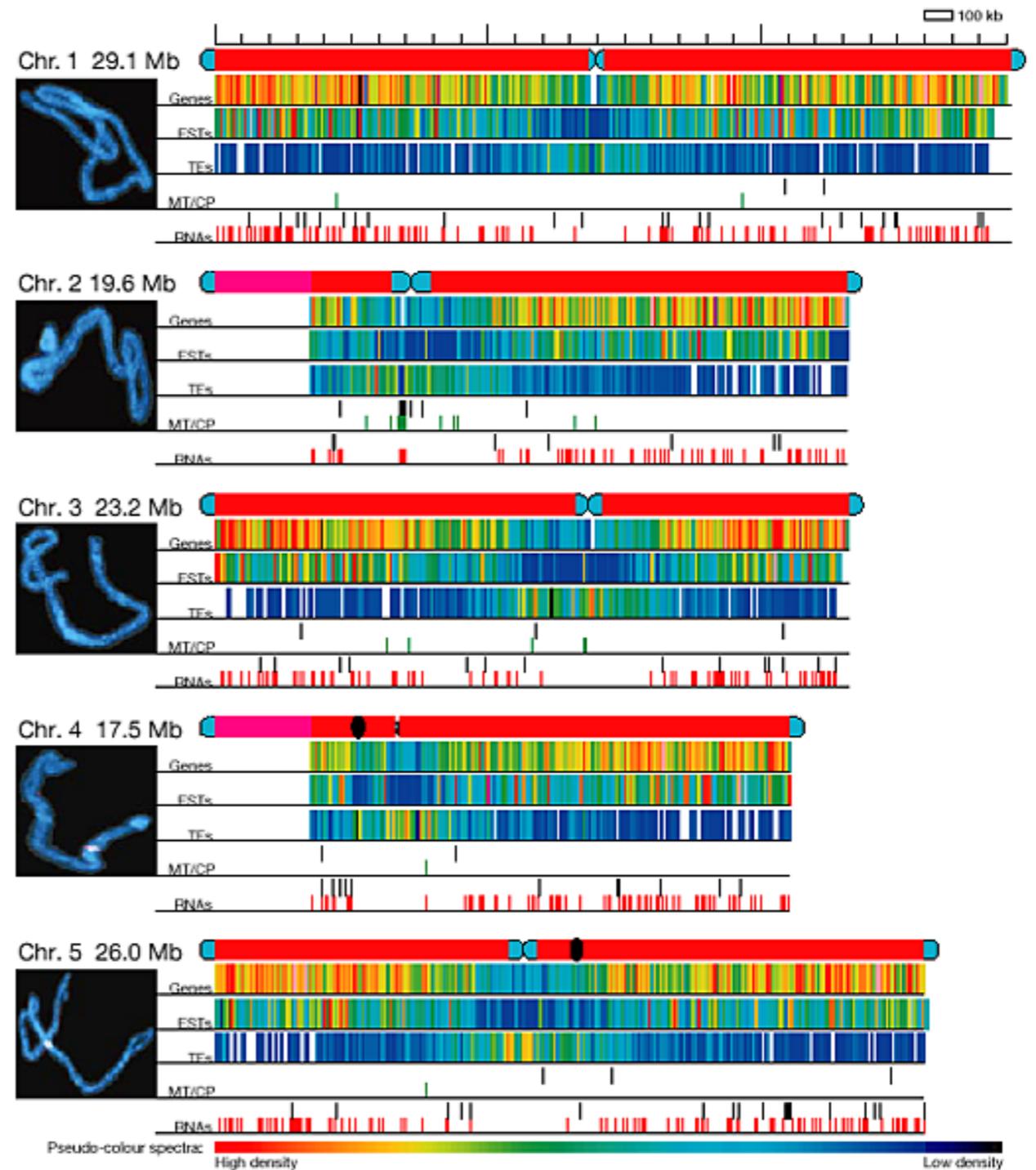




Deposition of new cell walls during plant cell division.

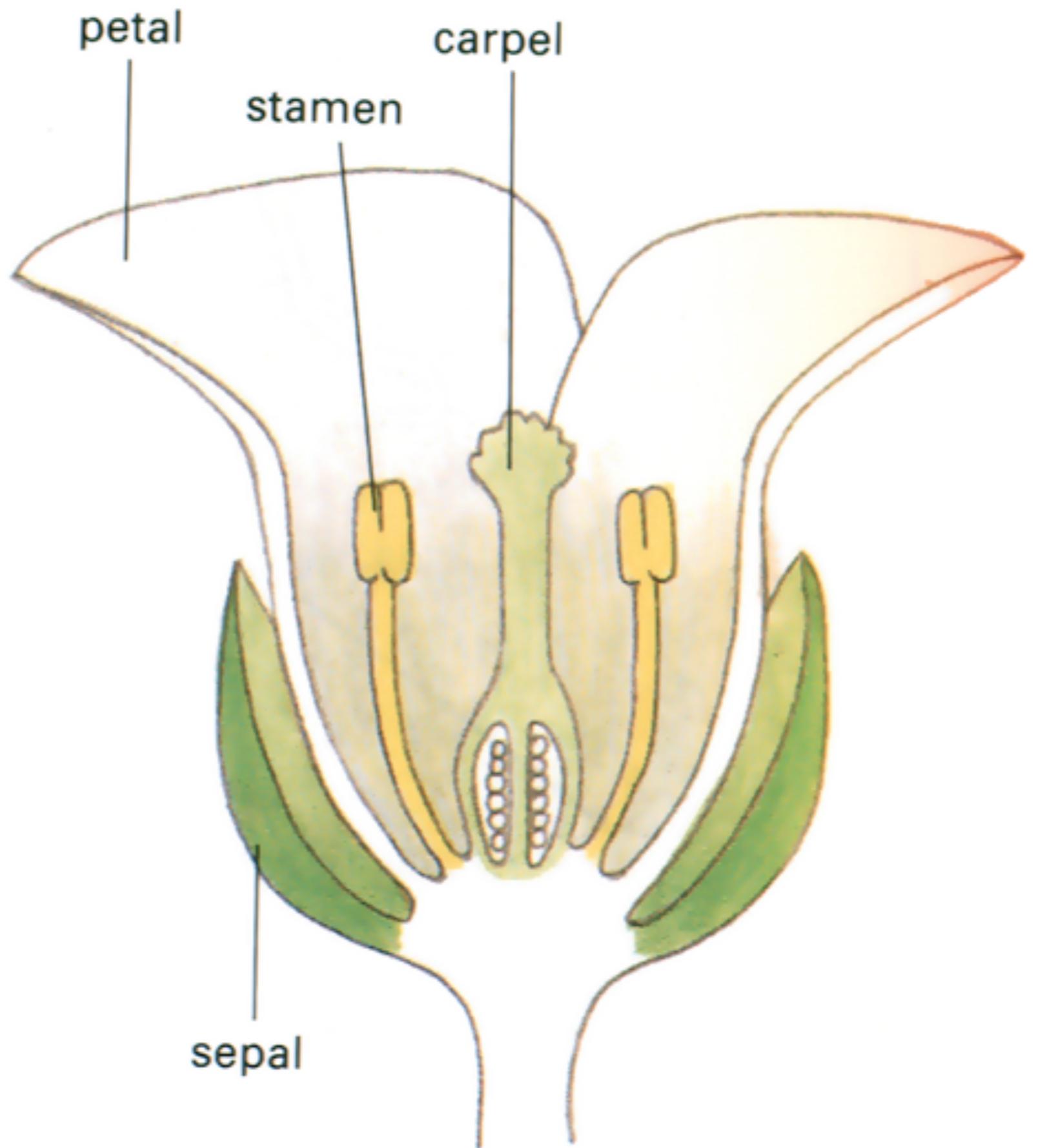
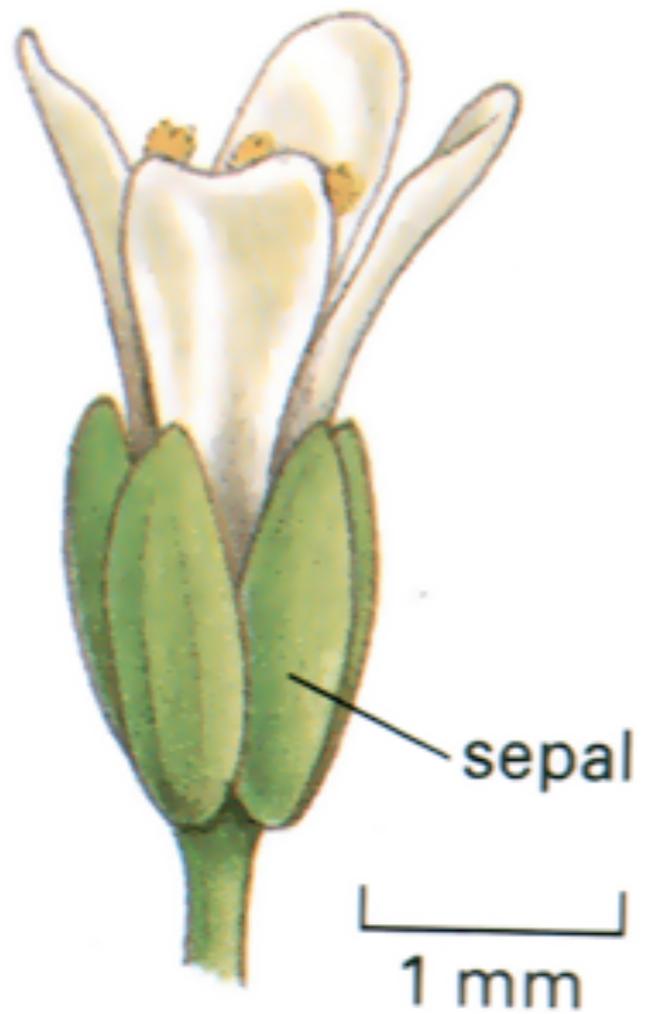
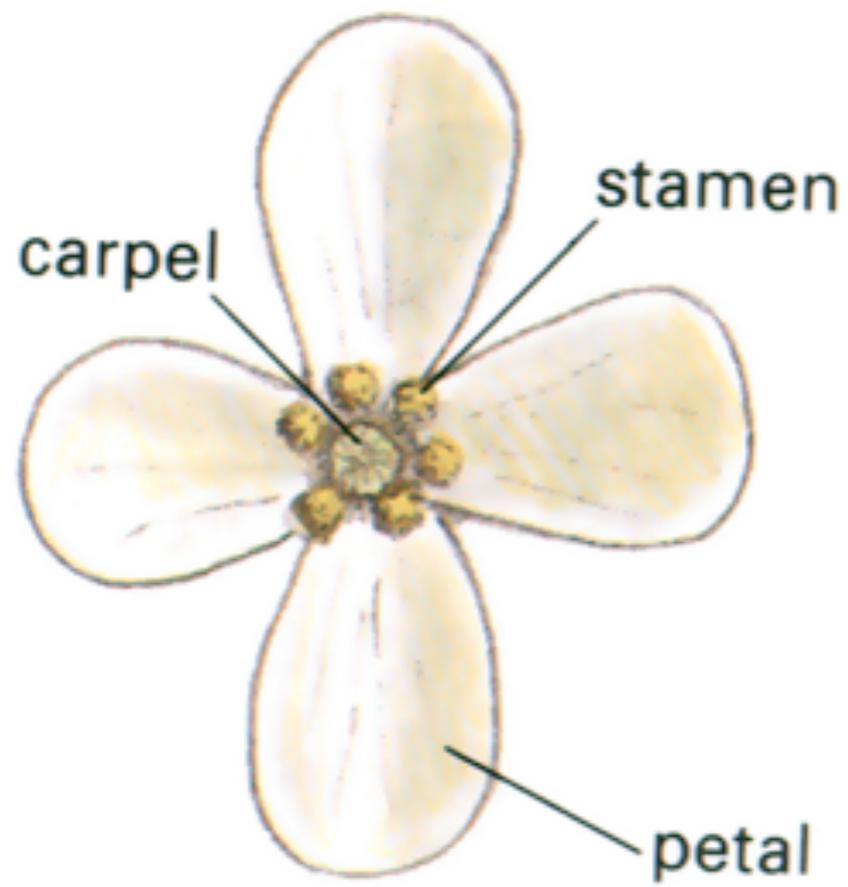
Arabidopsis thaliana as a model plant system

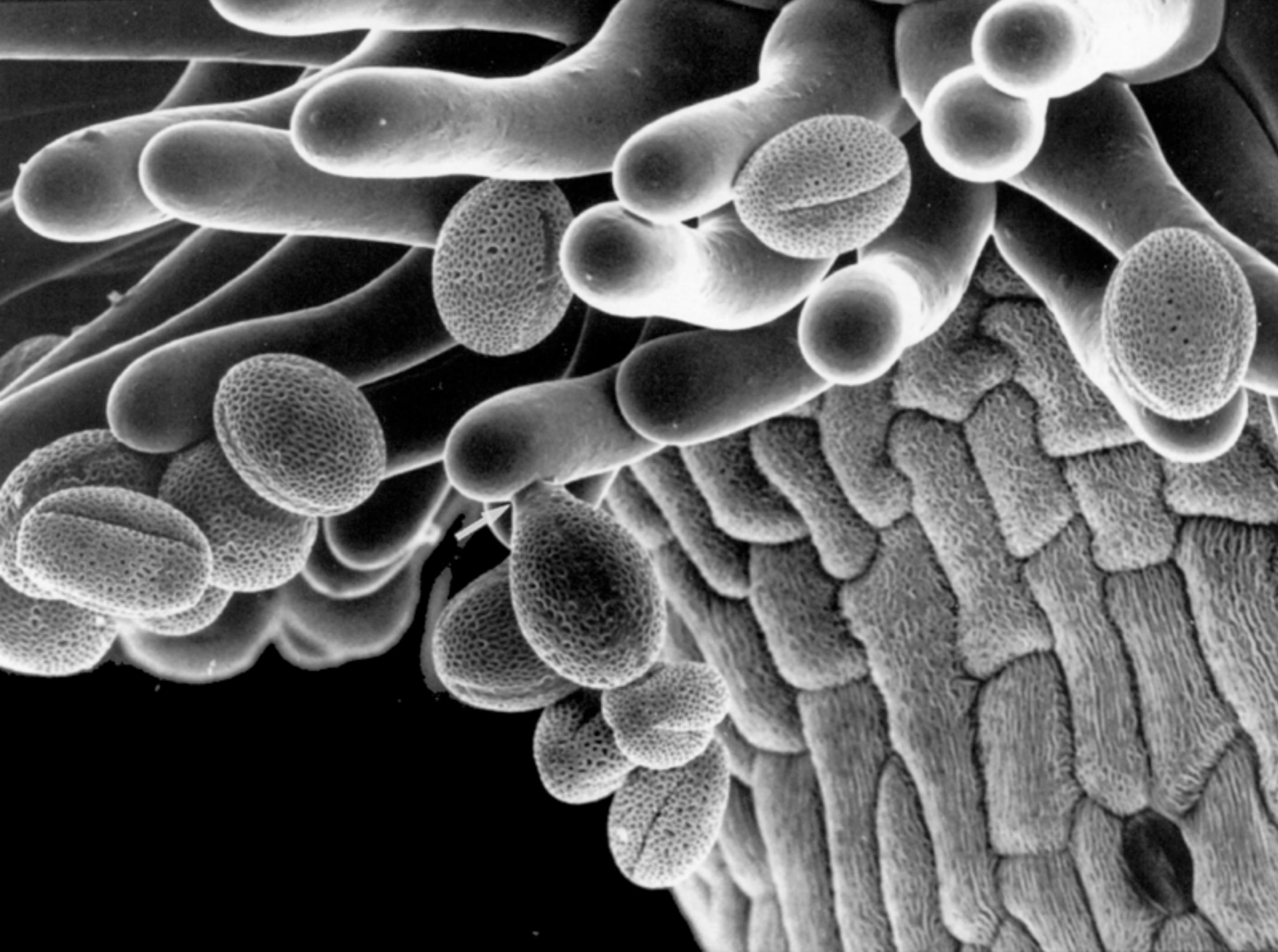


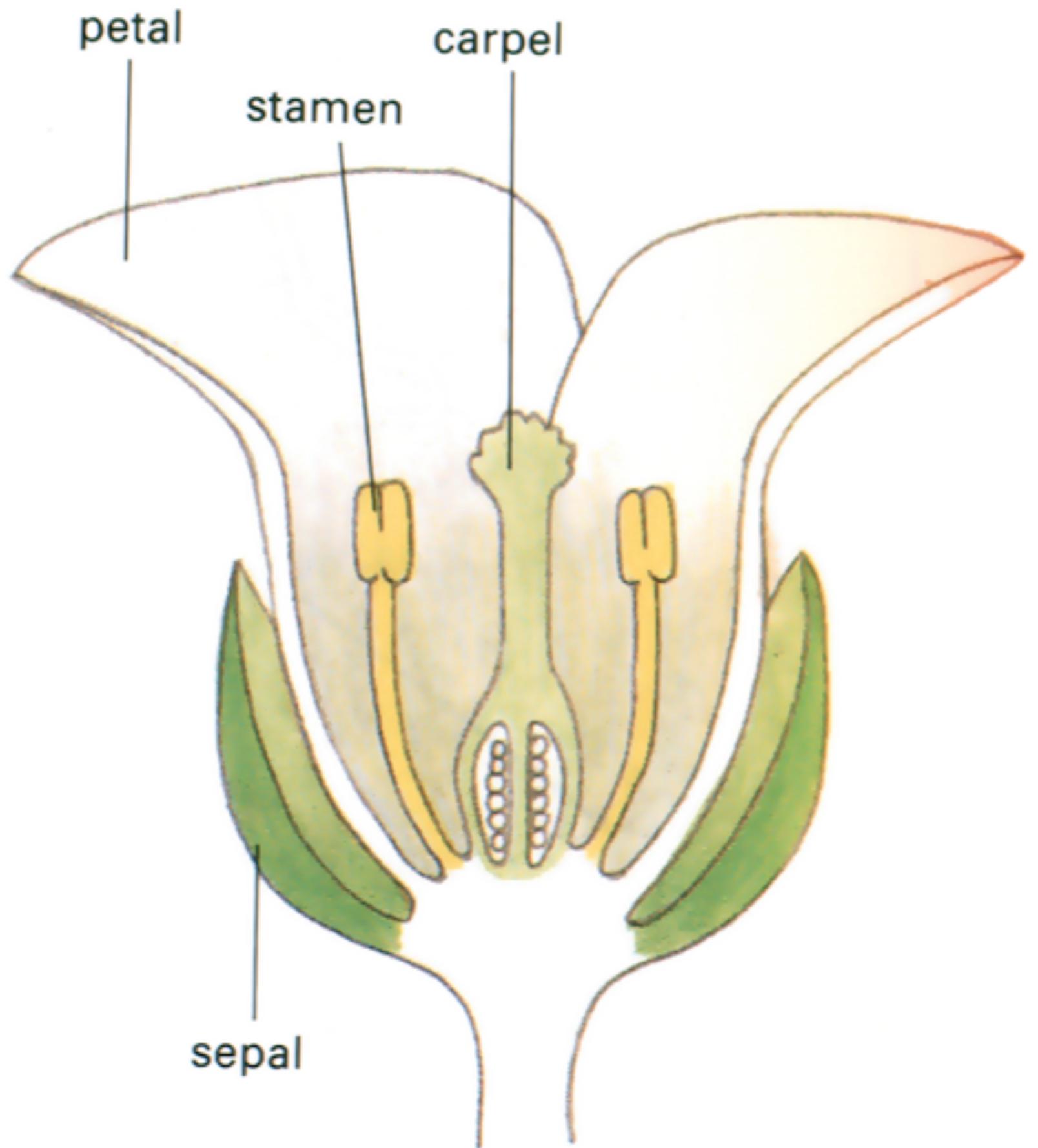
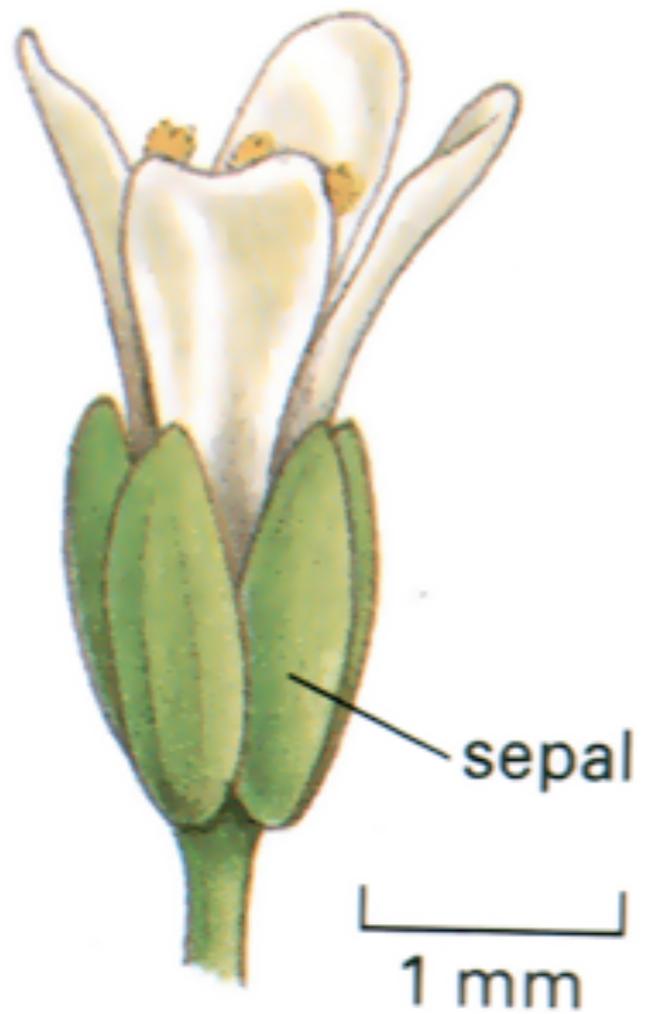
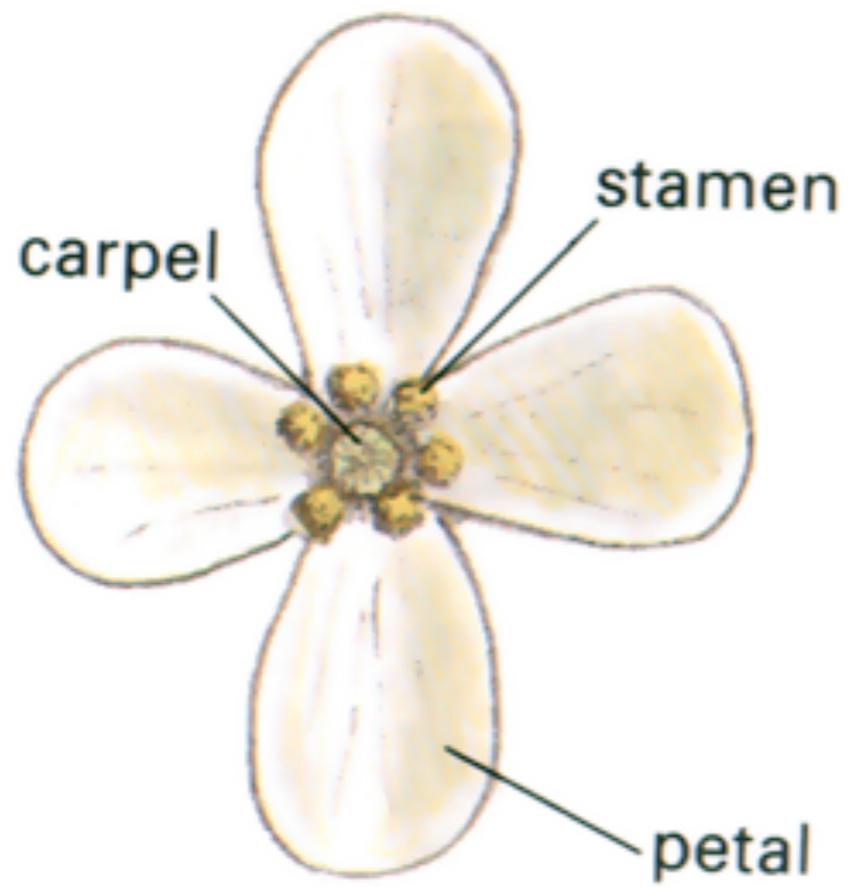


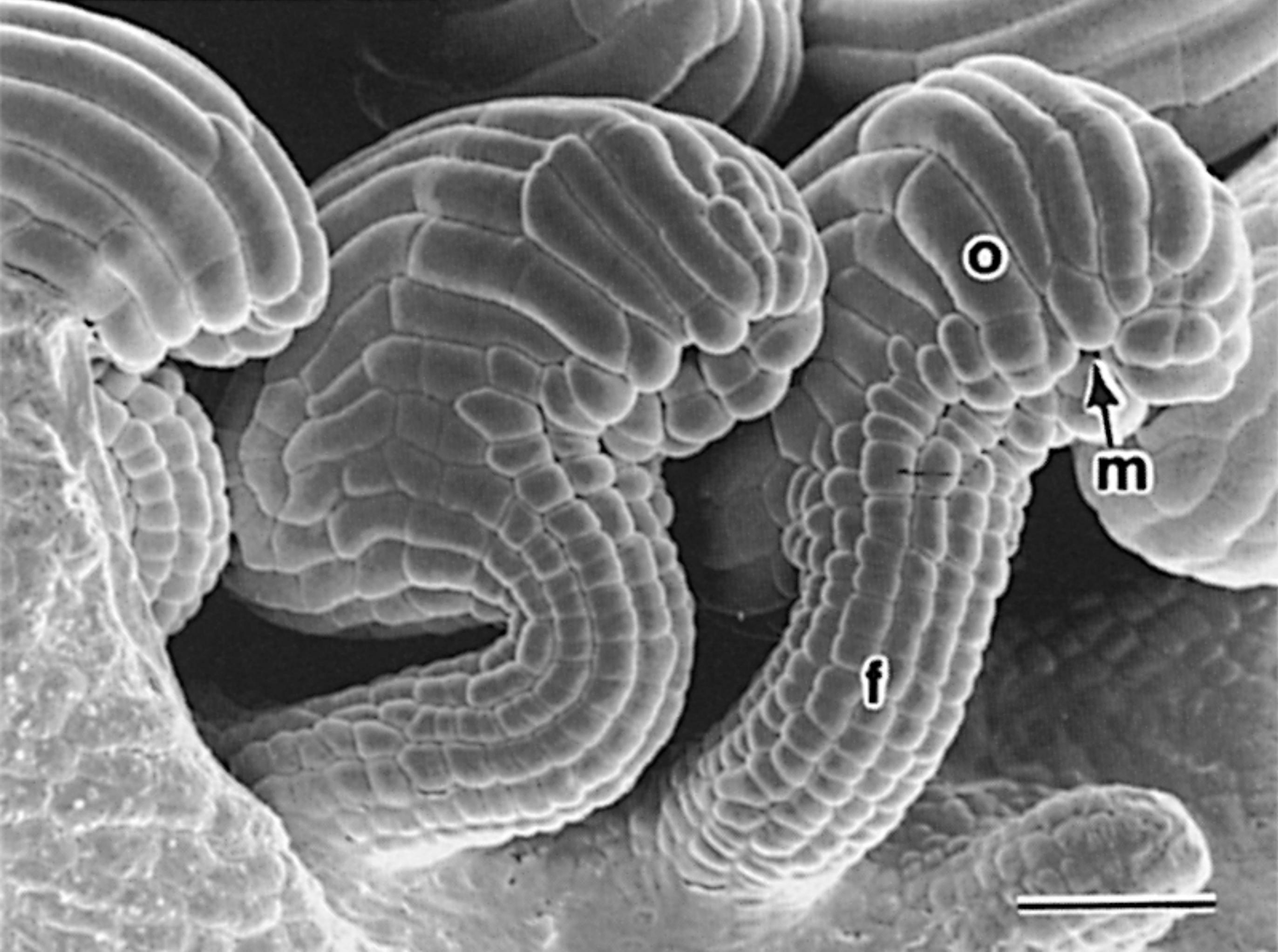
Arabidopsis thaliana has the best characterised plant genome.

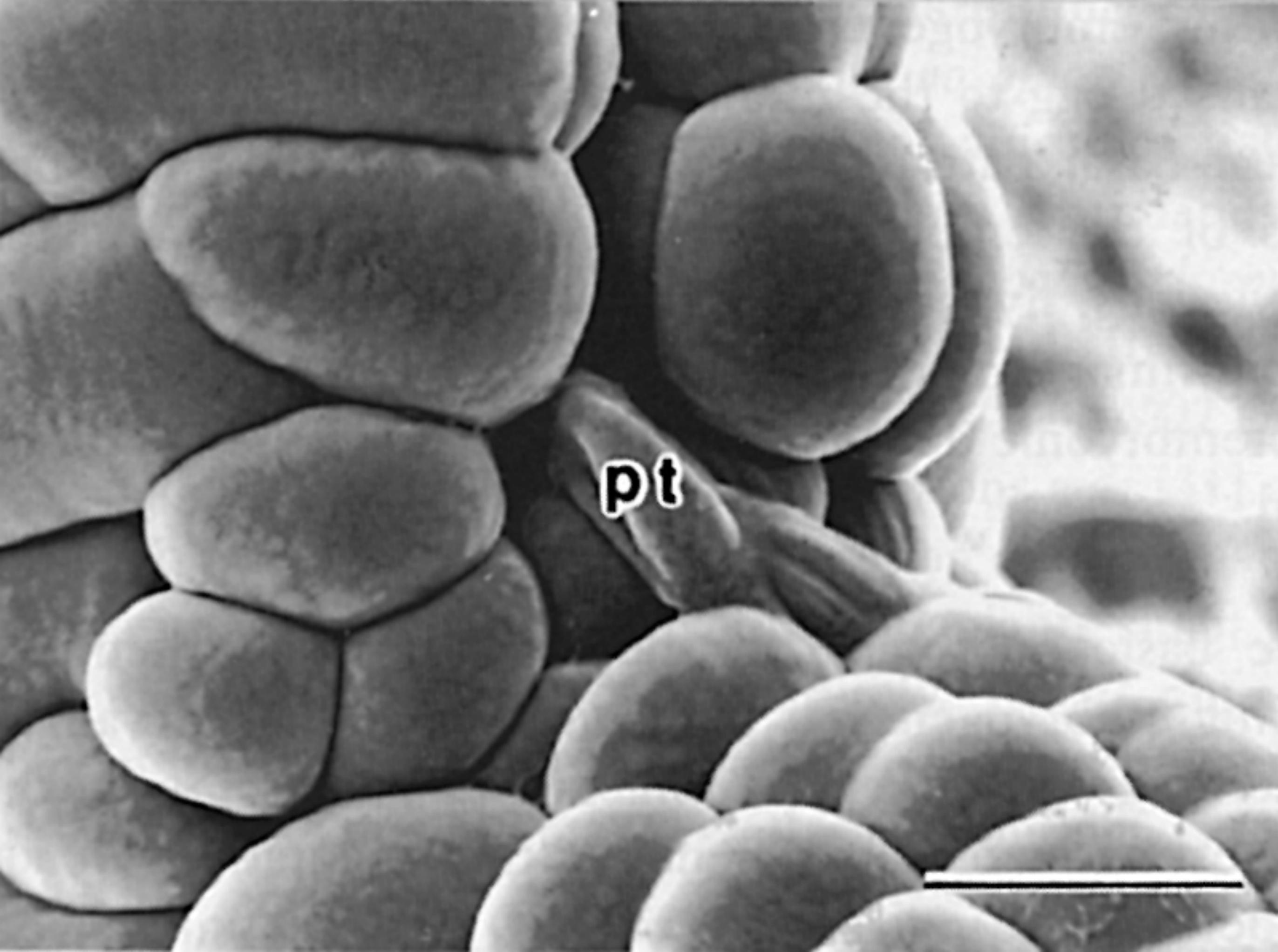






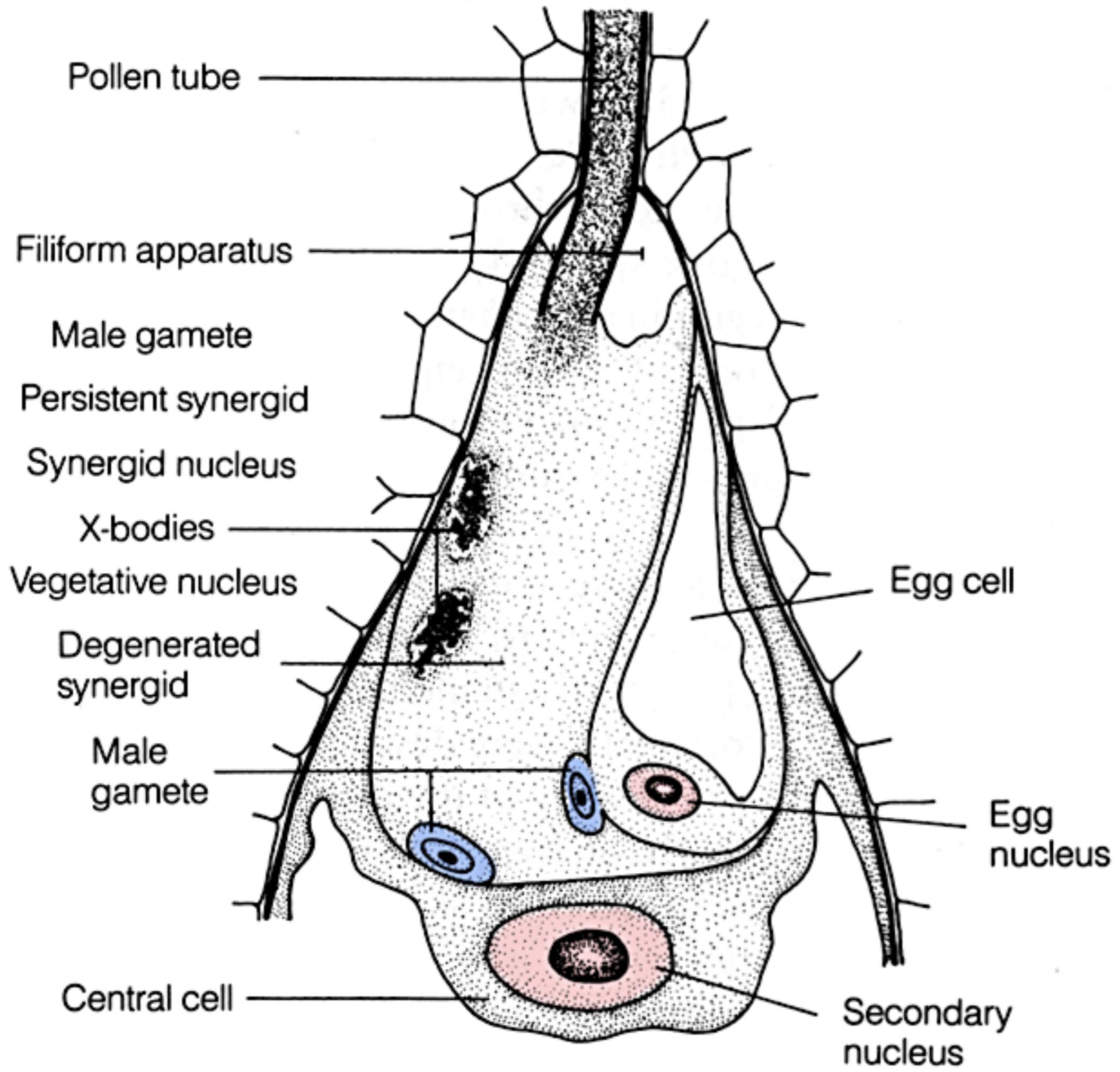






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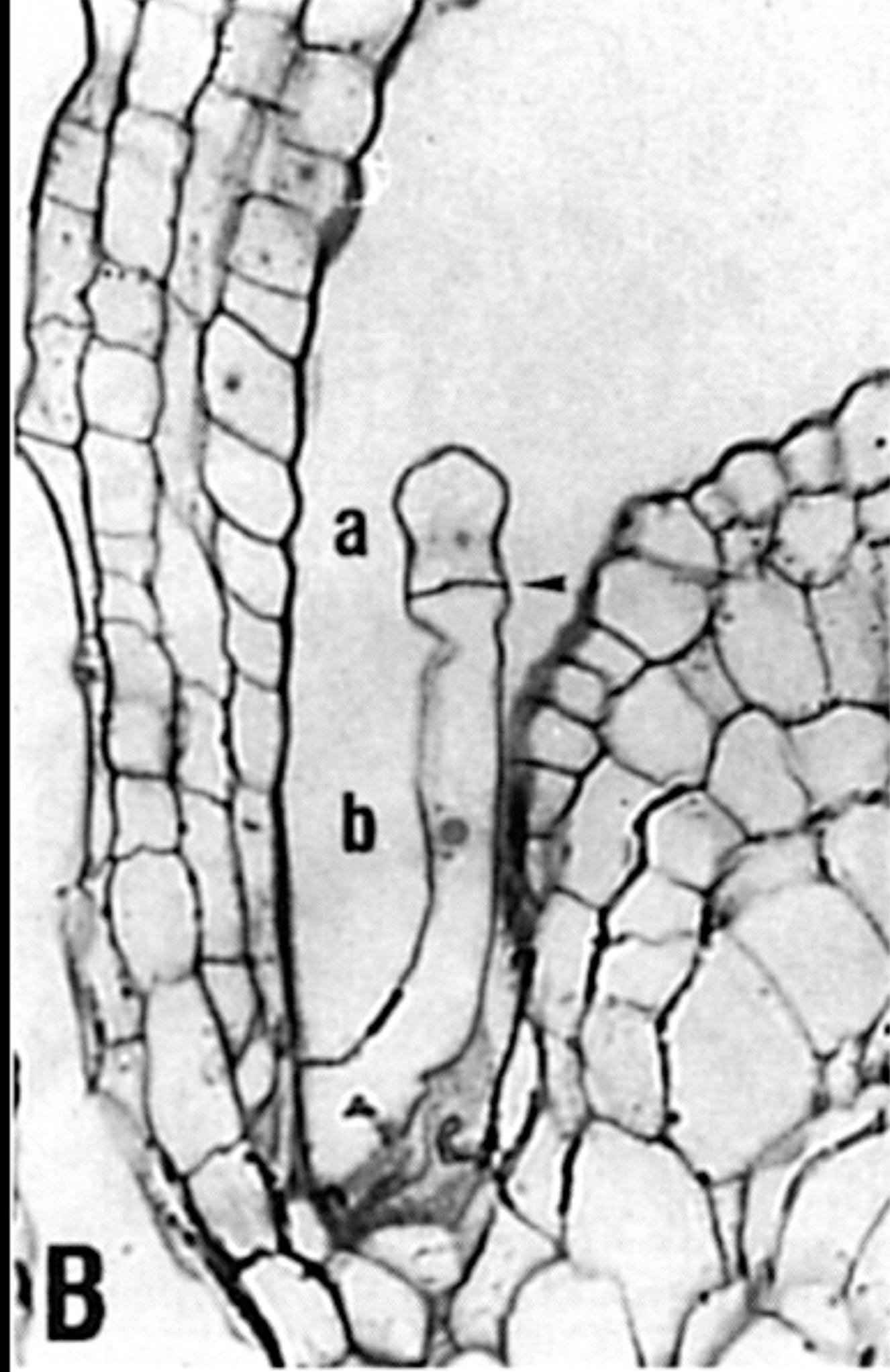






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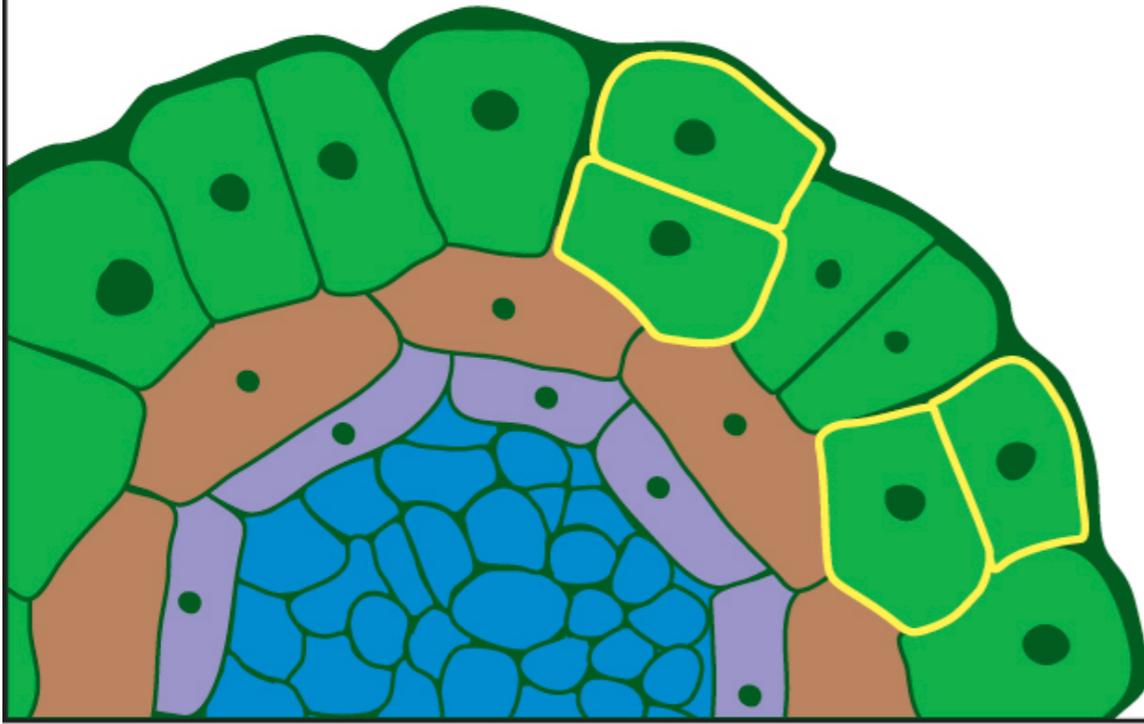




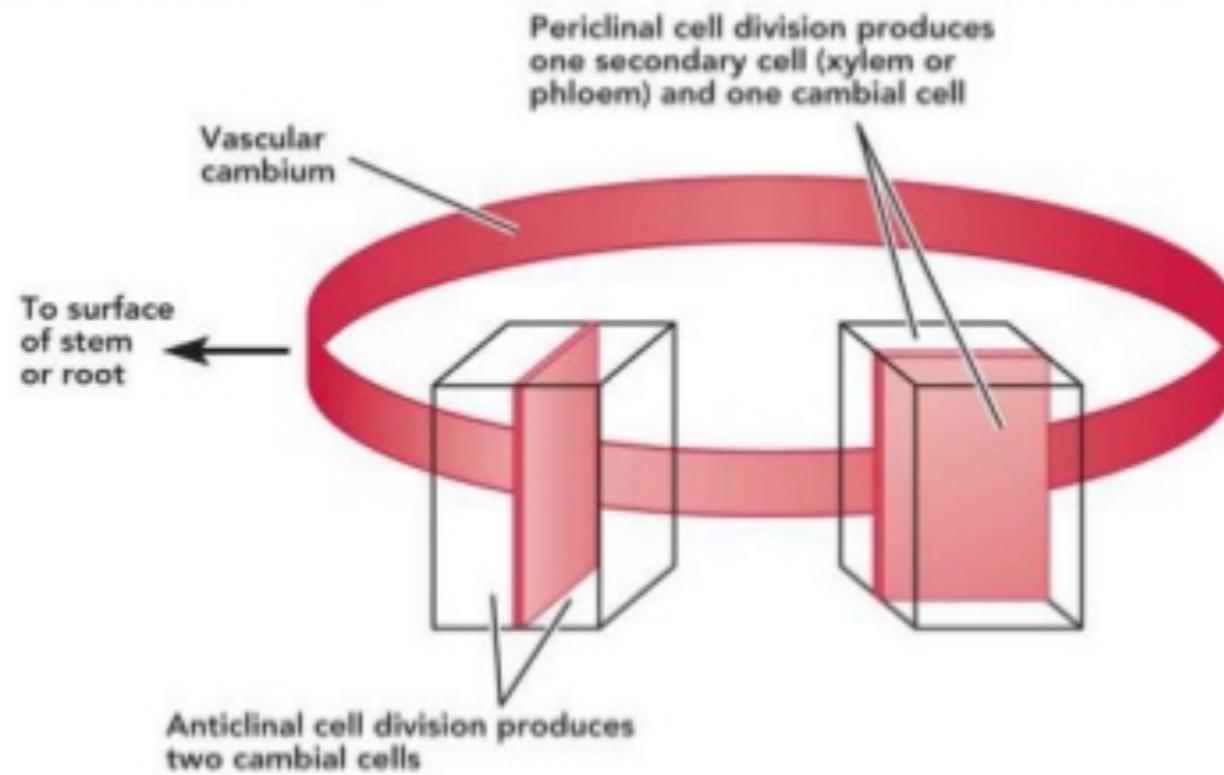
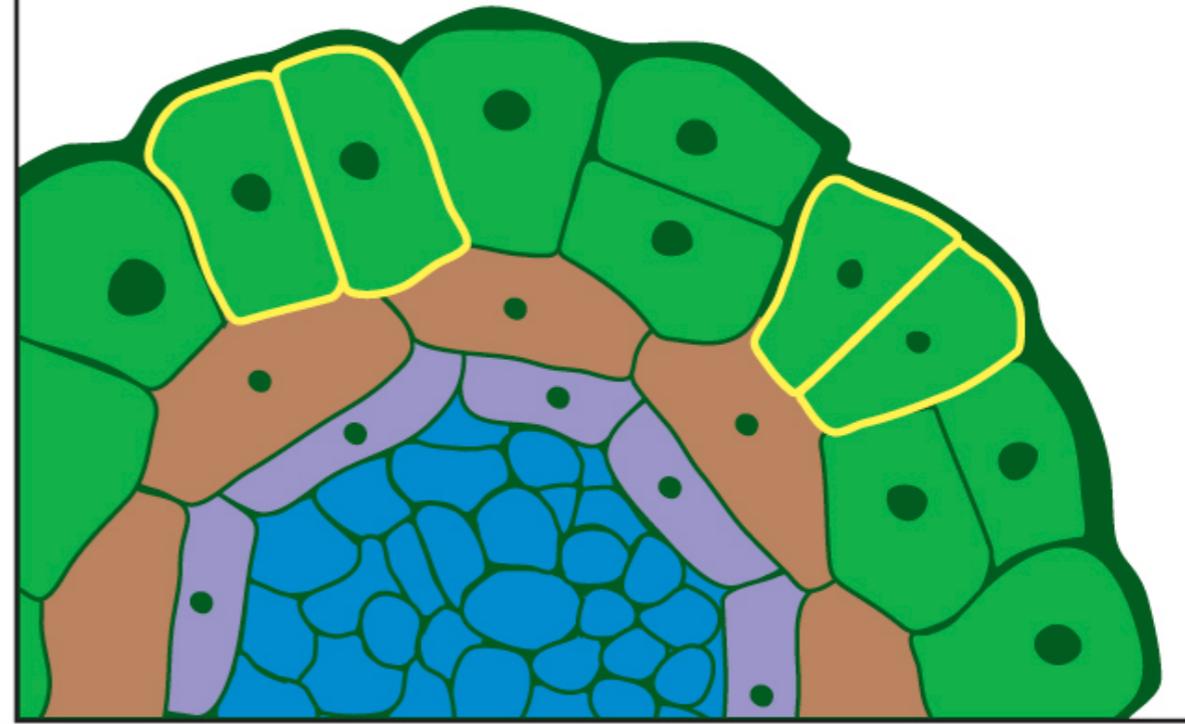
Octant stage embryo

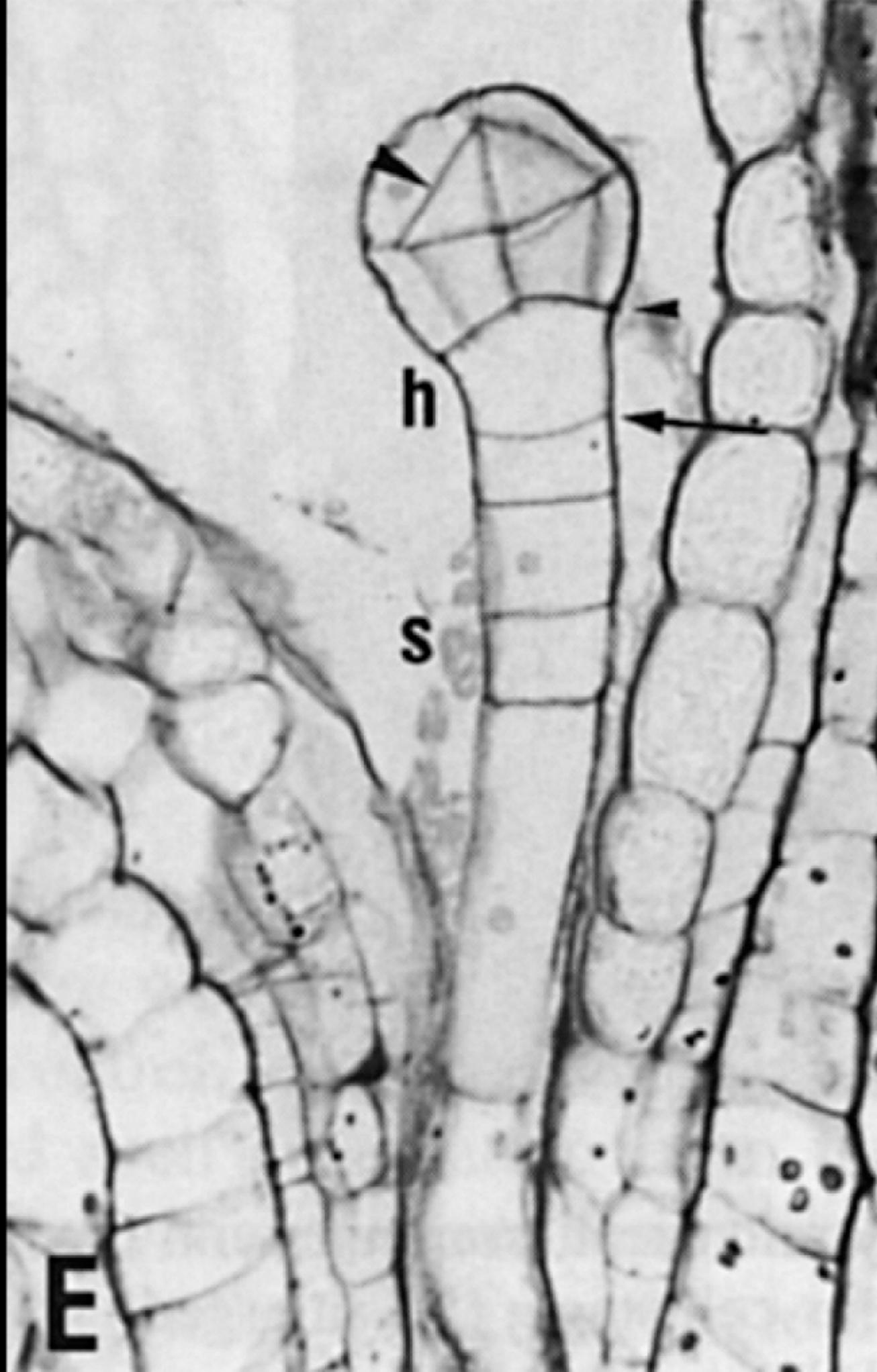


Periclinal divisions

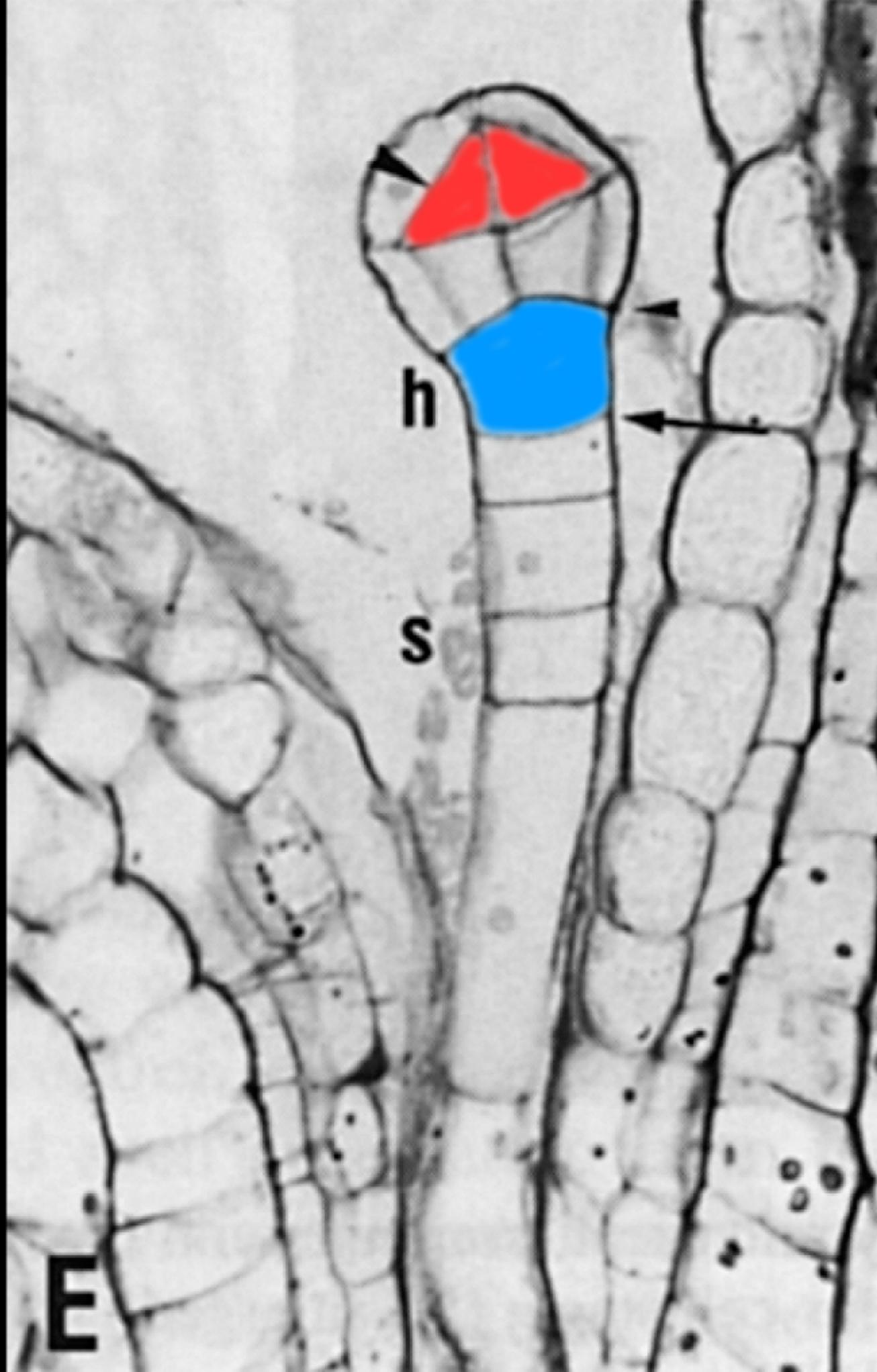


Anticlinal divisions





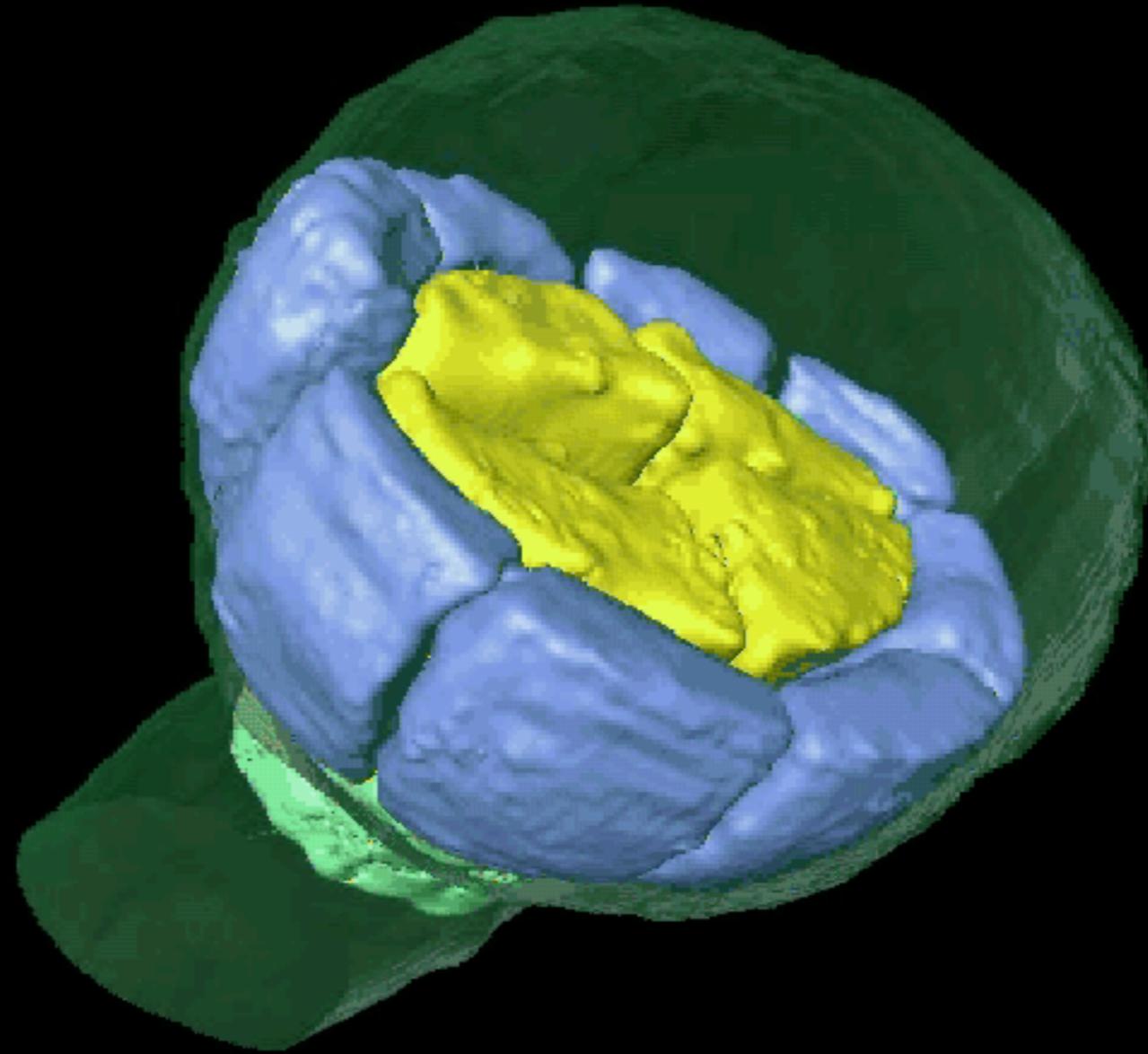
Radial asymmetry in
the 16-cell embryo

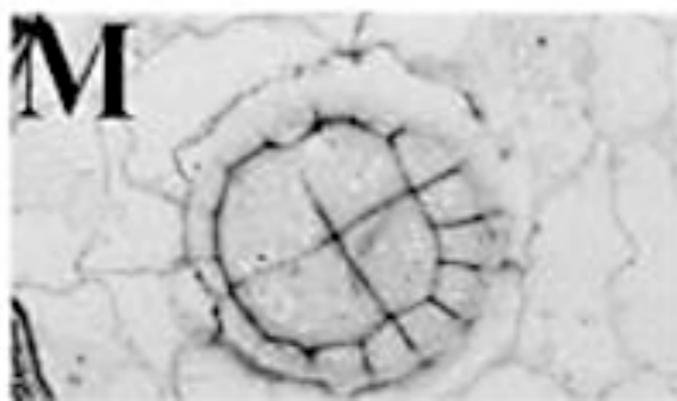
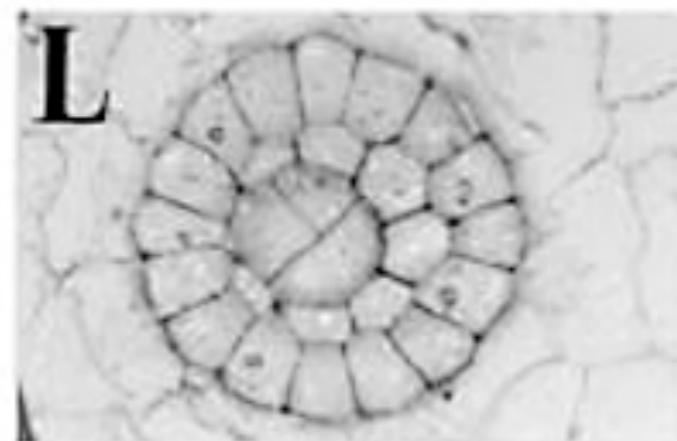
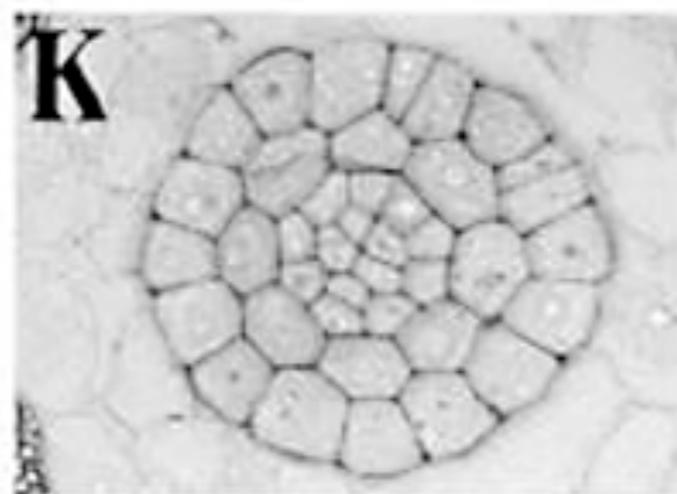
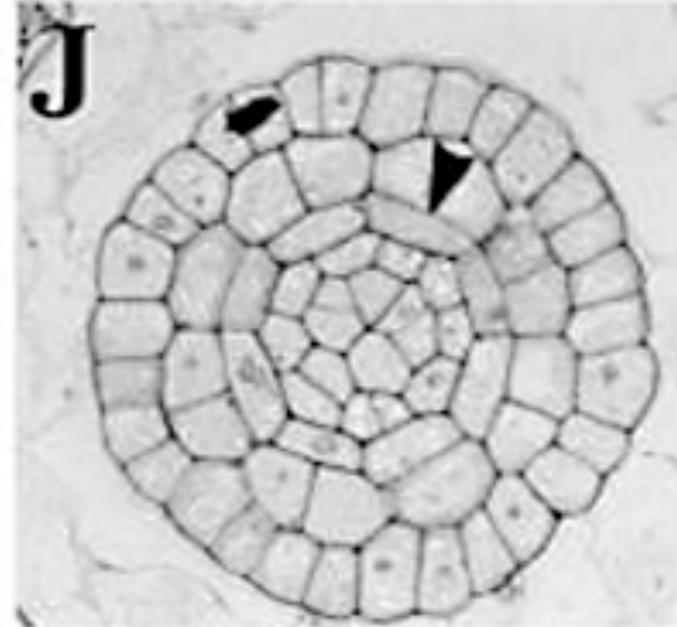
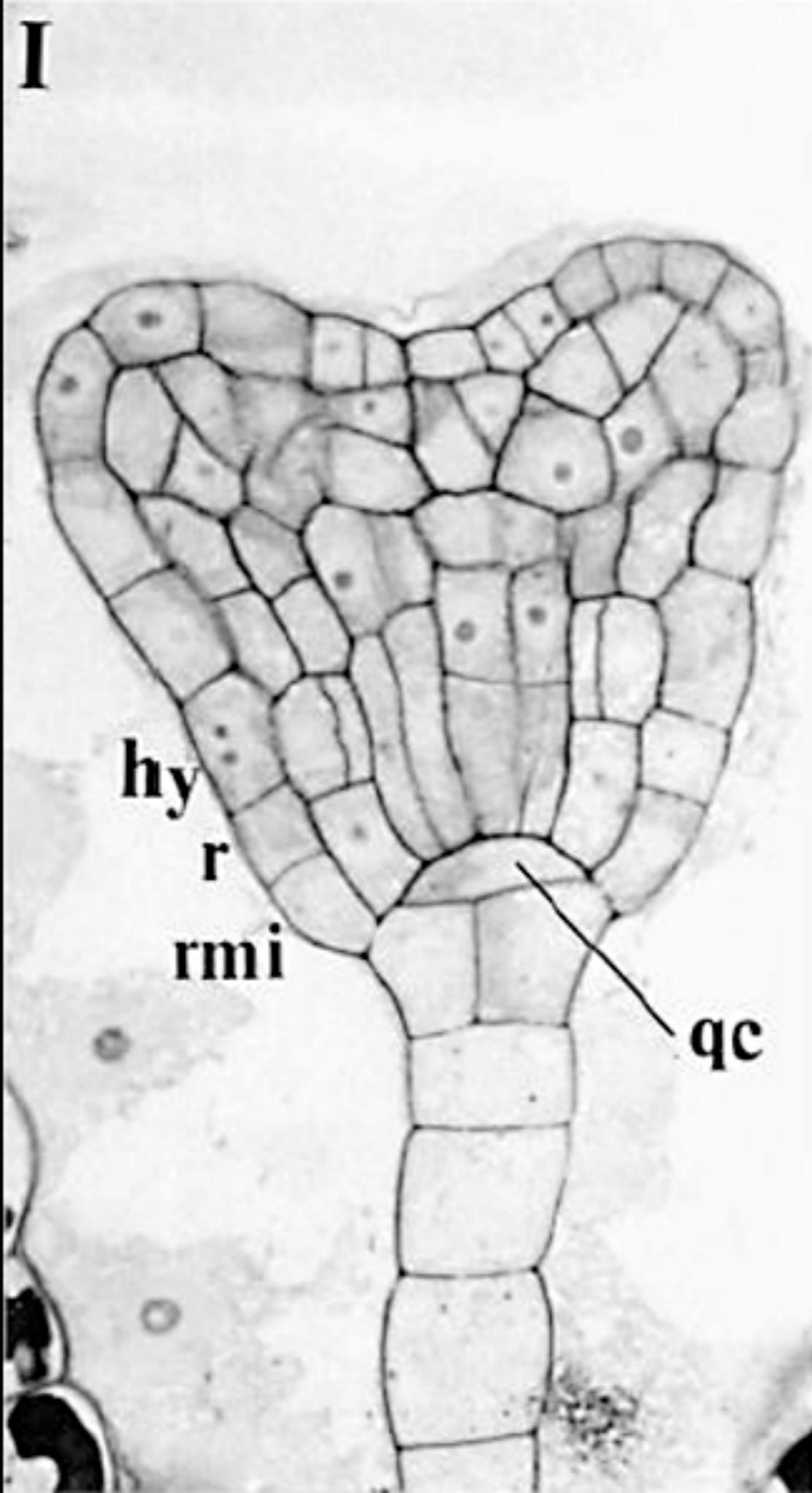


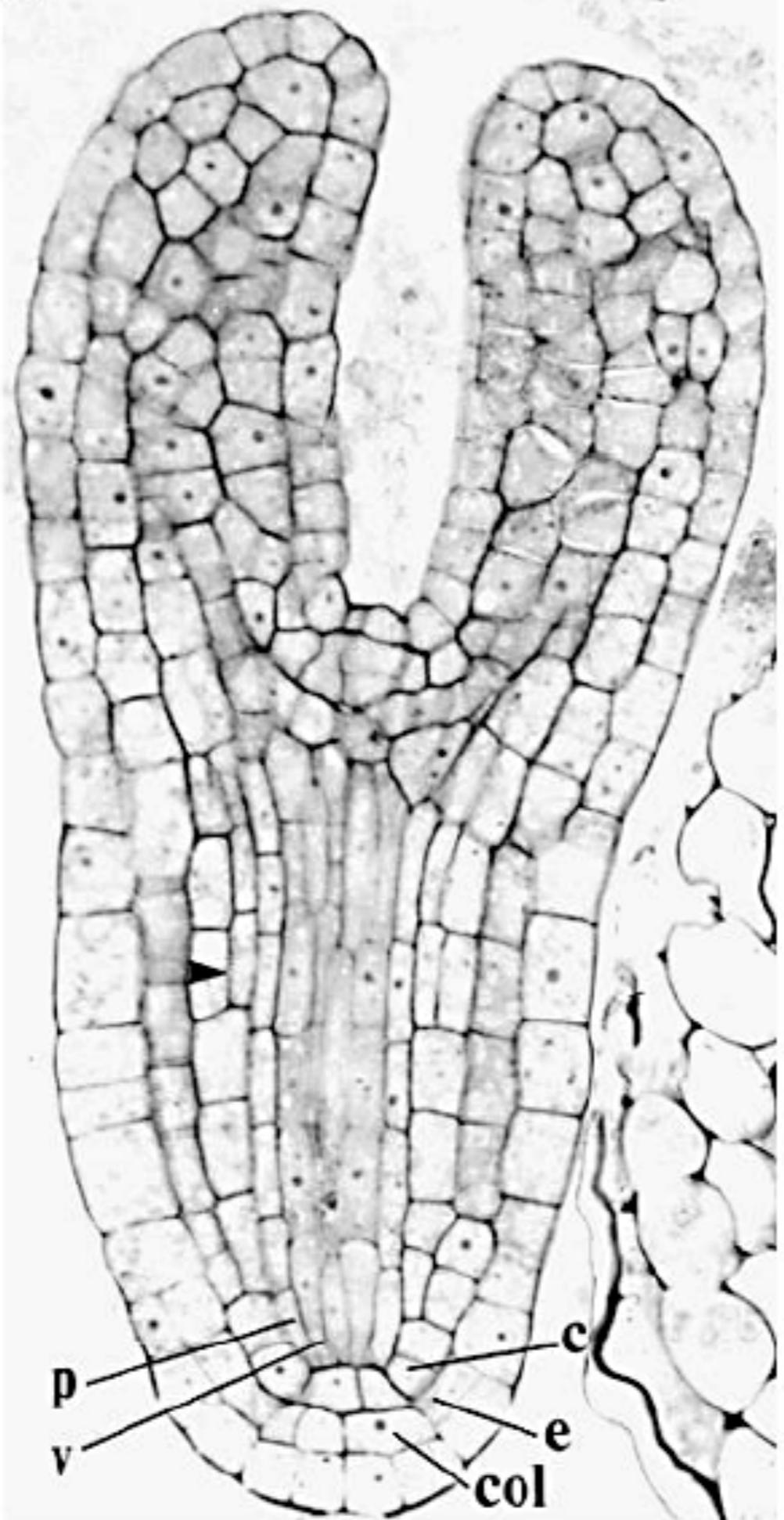
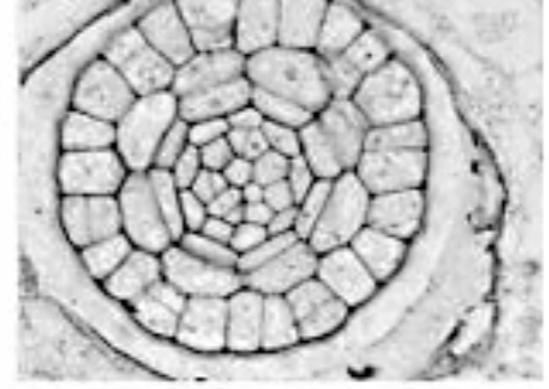
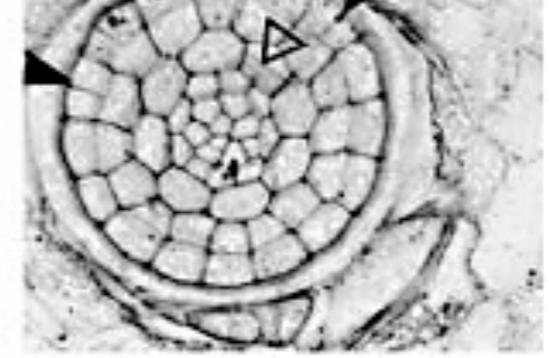
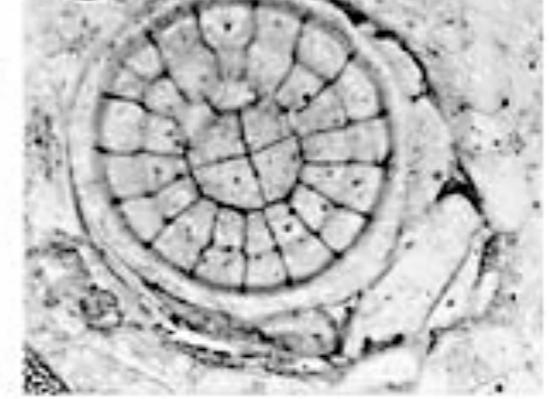
Radial asymmetry in
the 16-cell embryo

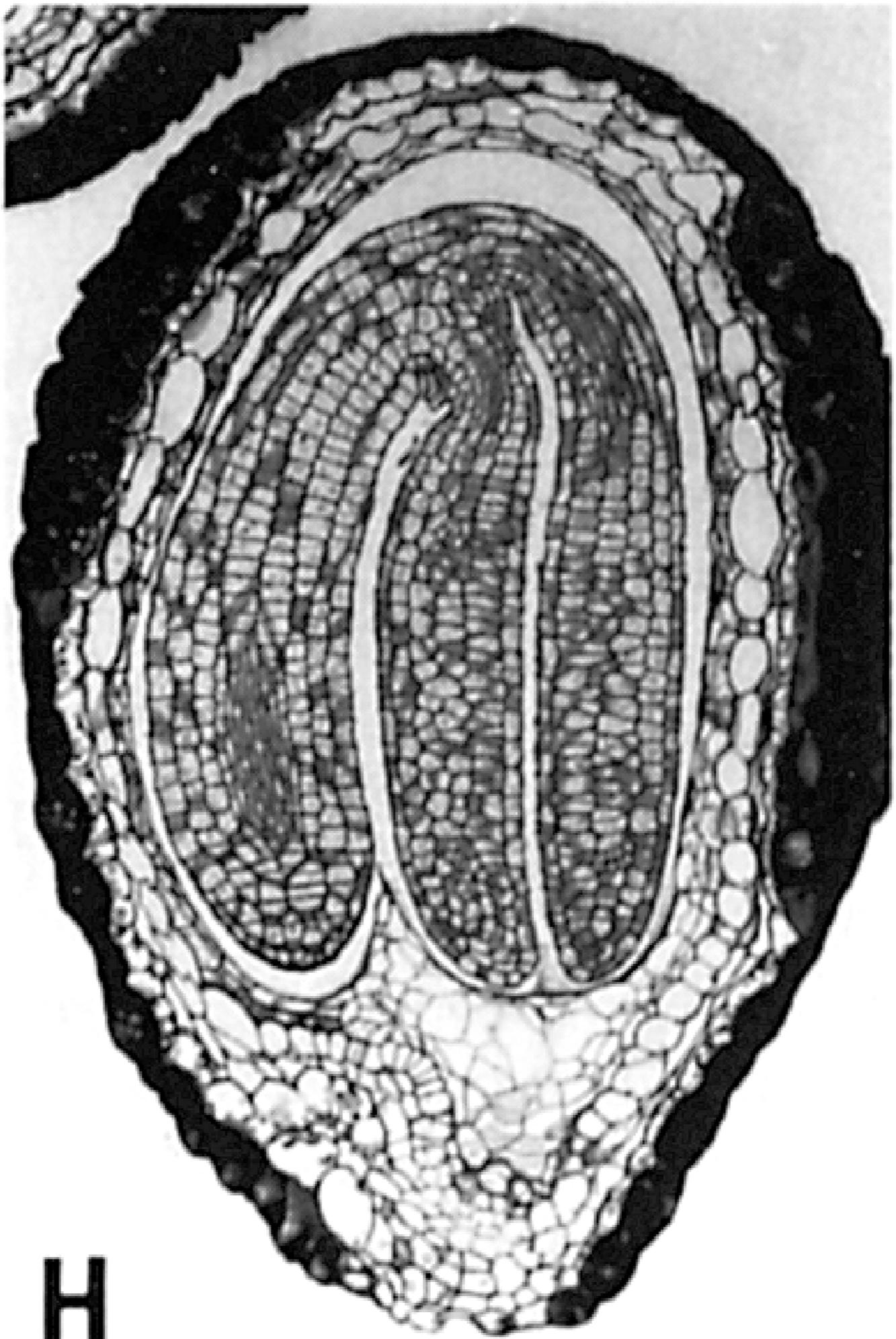
Specification of shoot
and root meristems

Protoderm stage embryo



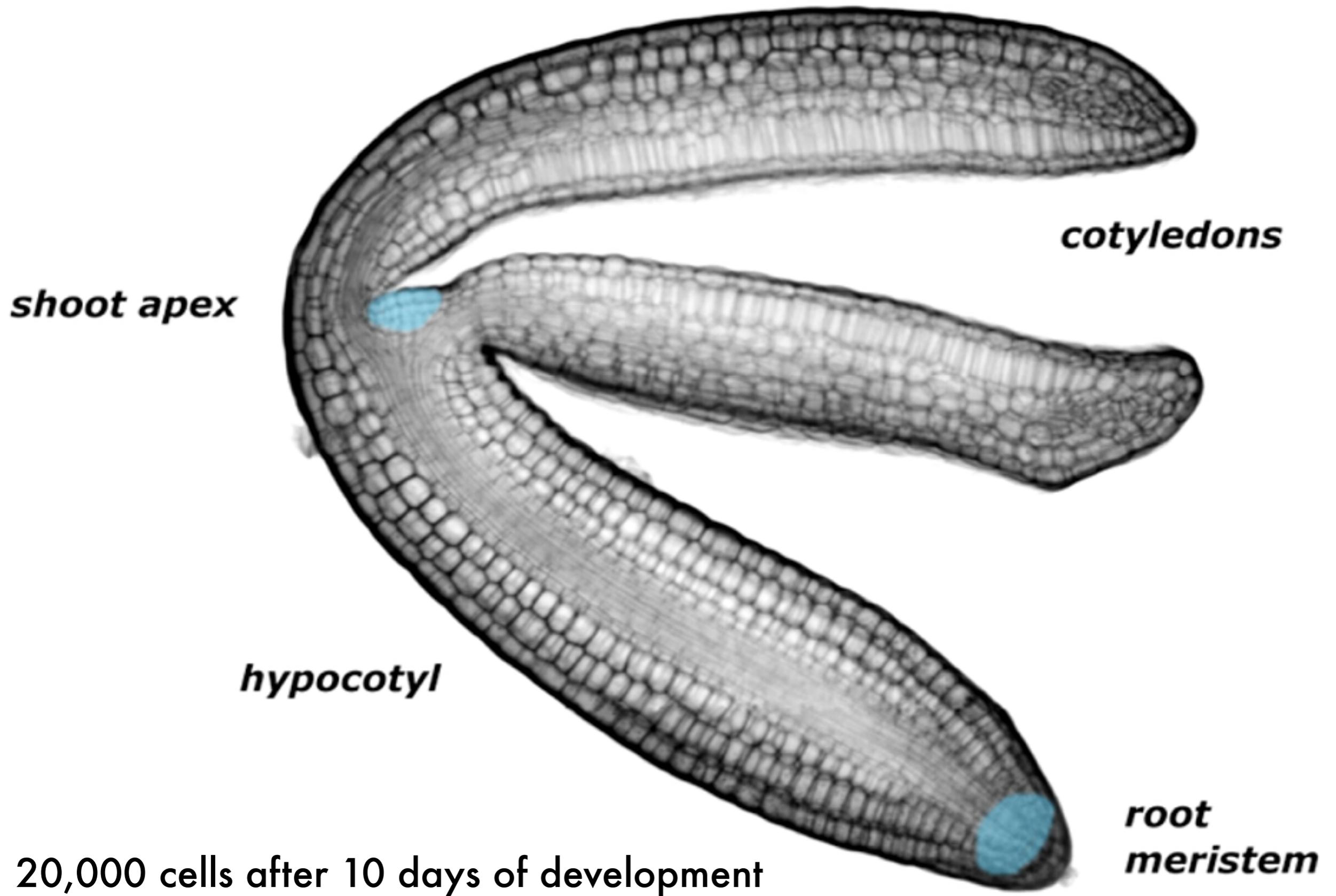


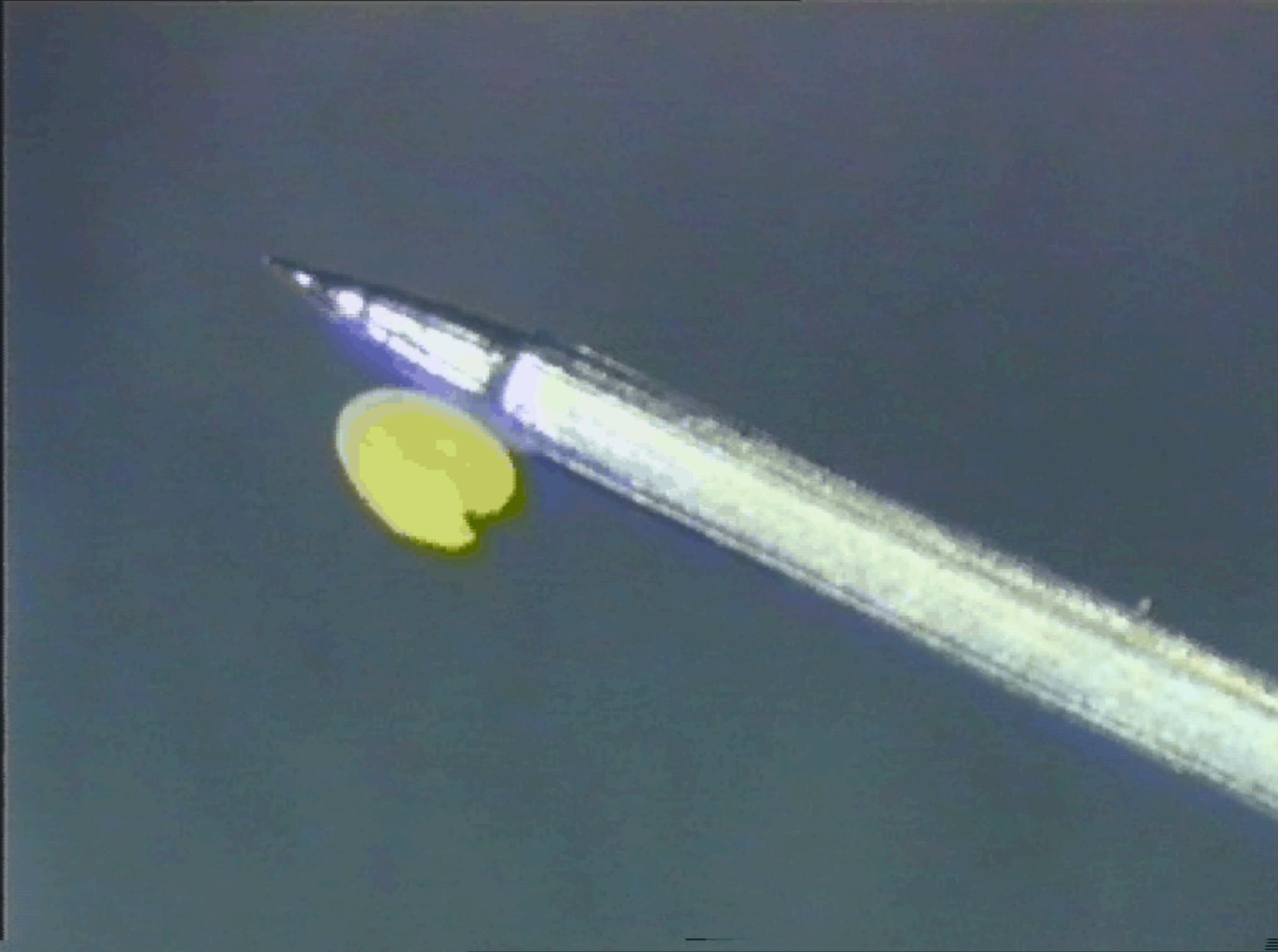
N**O****P****Q****R**

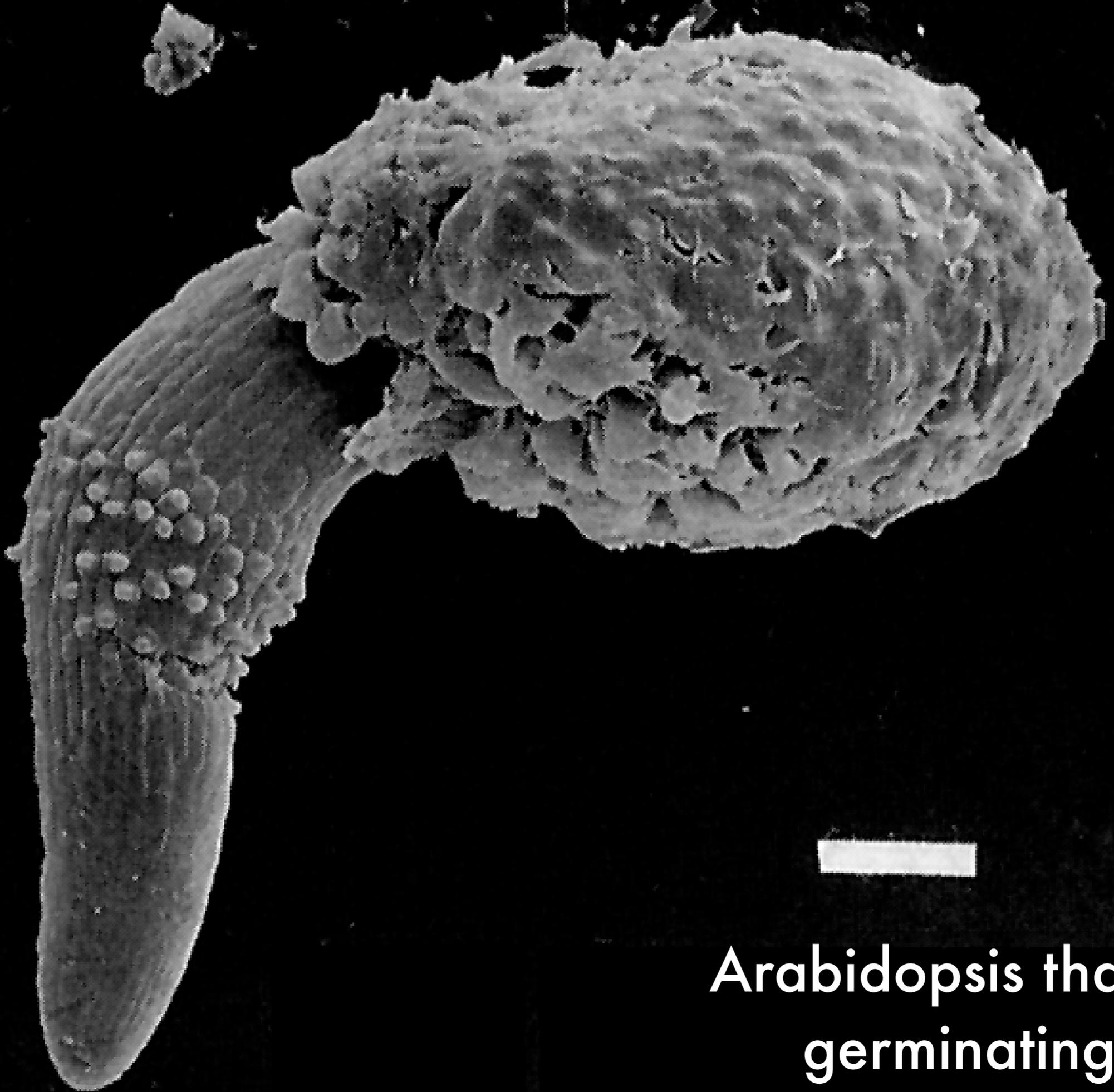


H

mature embryo





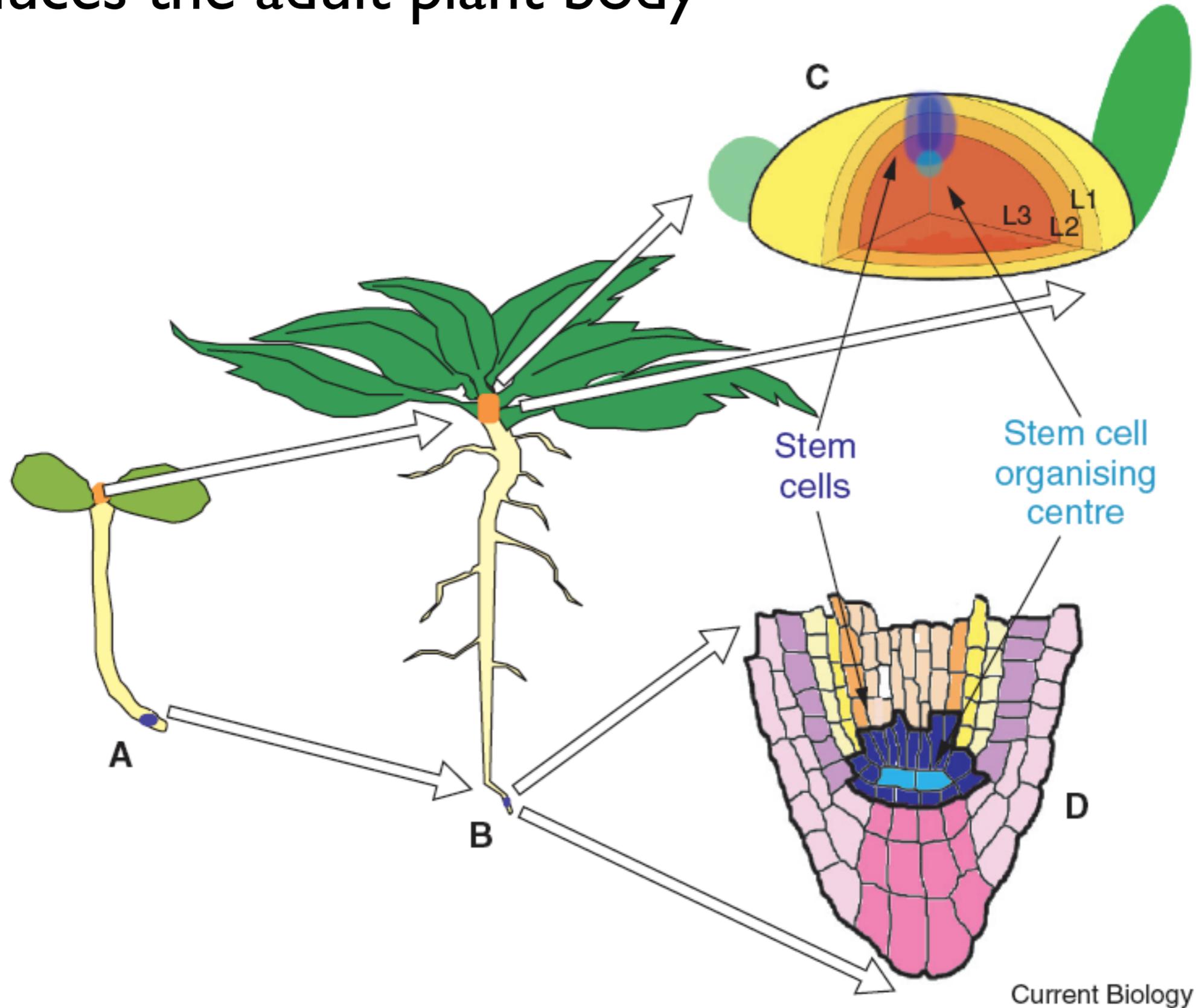


Arabidopsis thaliana
germinating seed



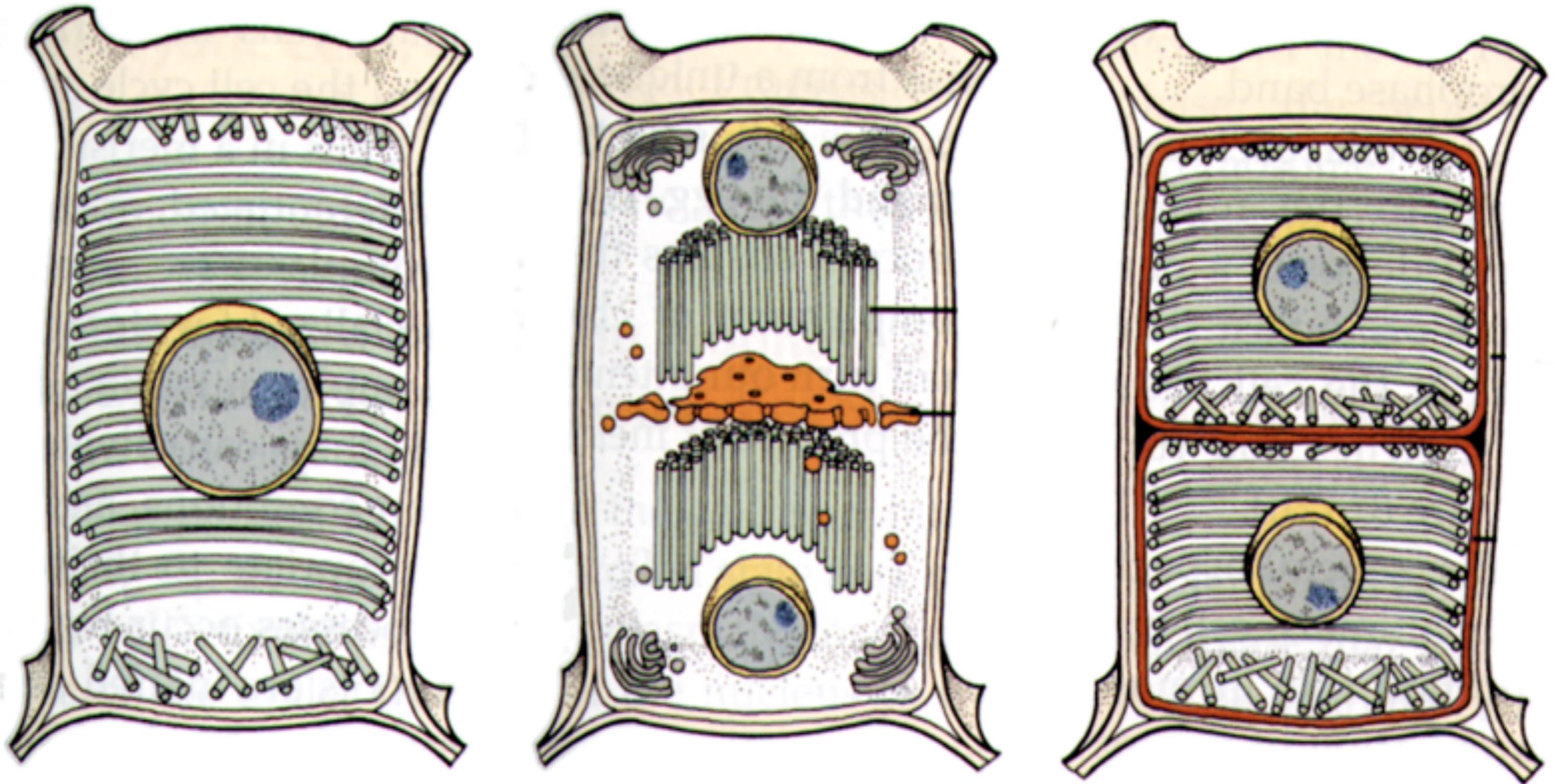
**Arabidopsis thaliana seedling
4 days after germination**

Continued growth of shoot and root meristems produces the adult plant body



Plant Morphogenesis





Deposition of new cell walls during plant cell division.

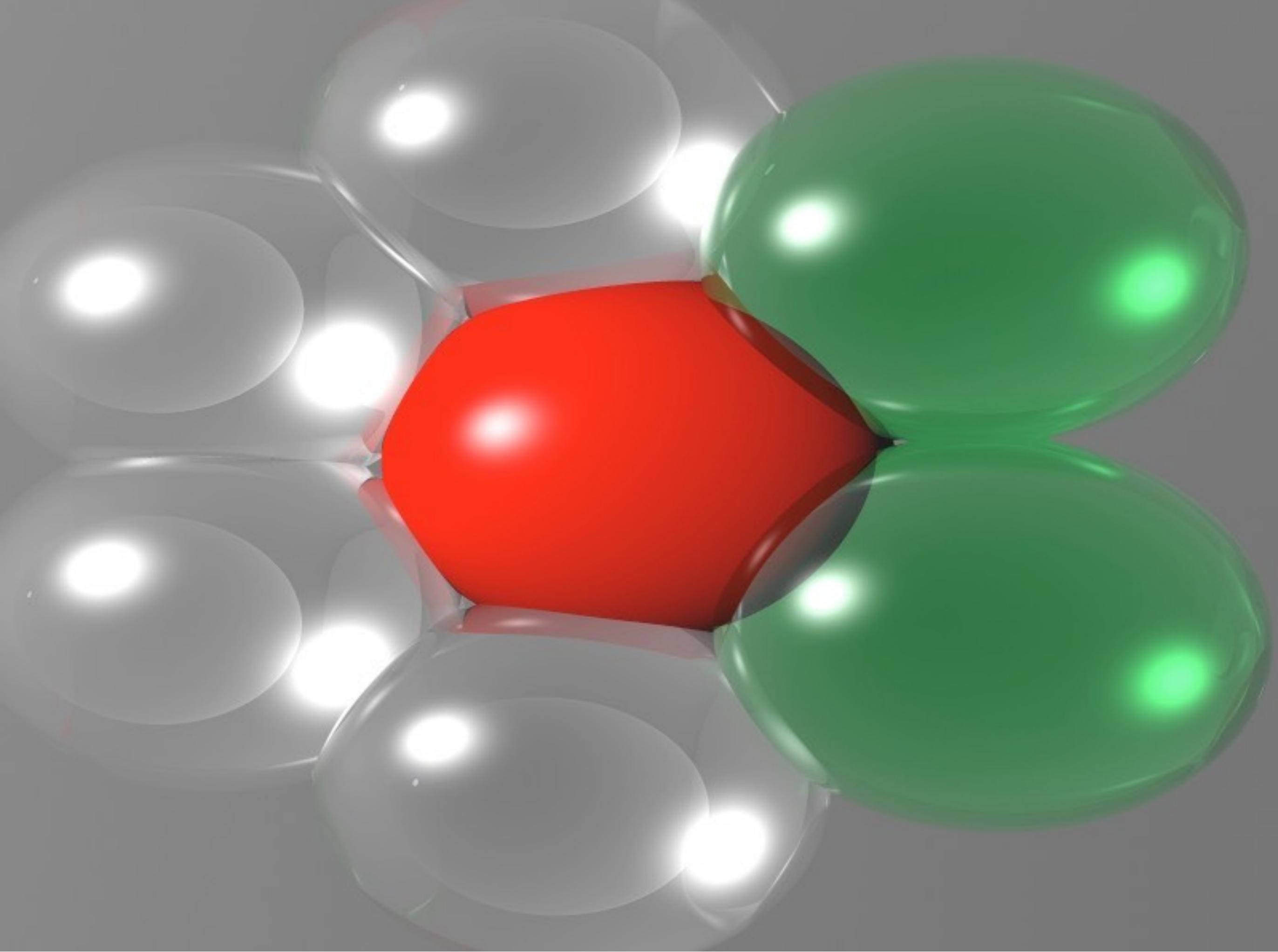
How is an adult body plan built?

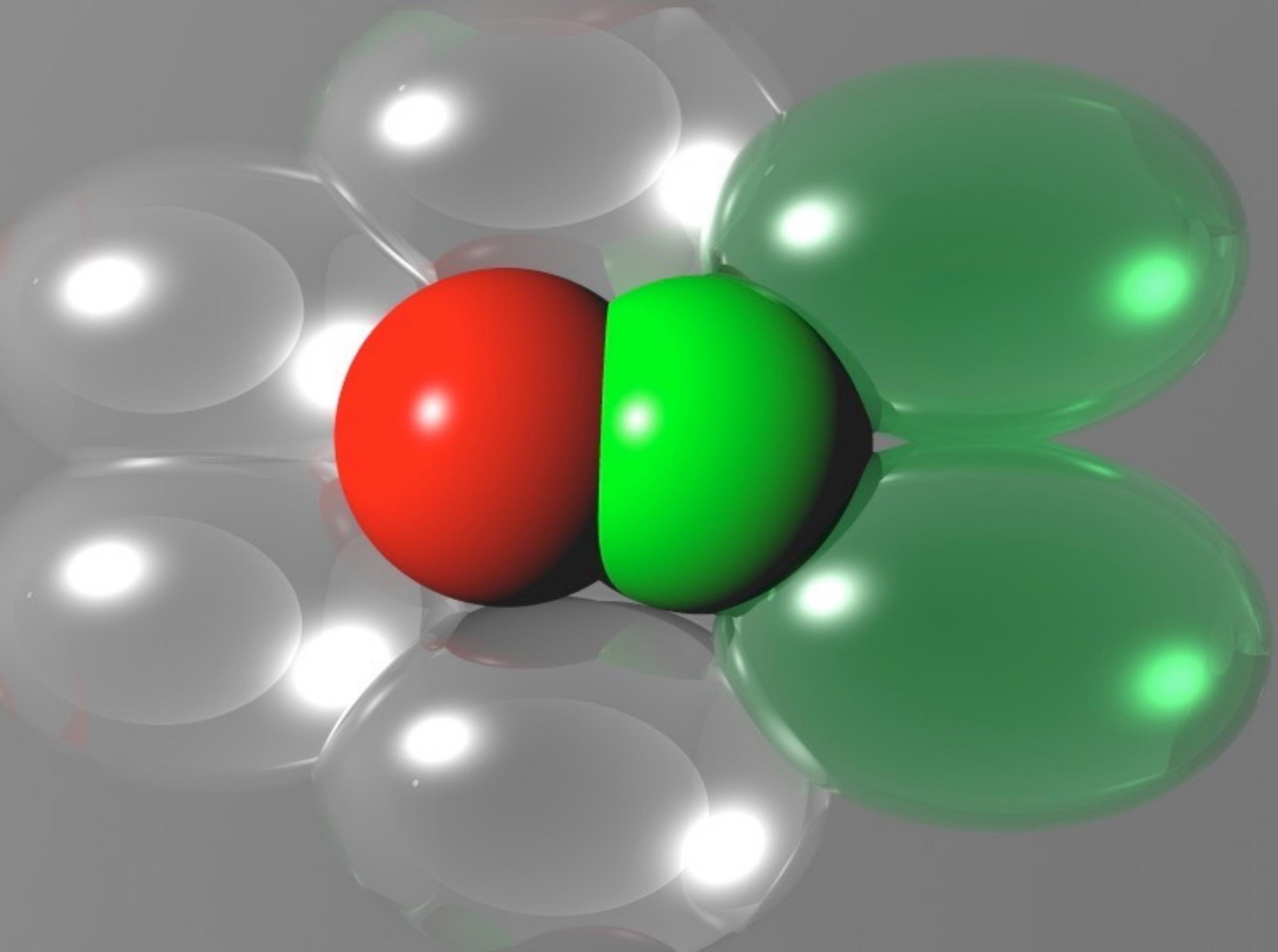
Precise sequence of divisions during early embryogenesis.

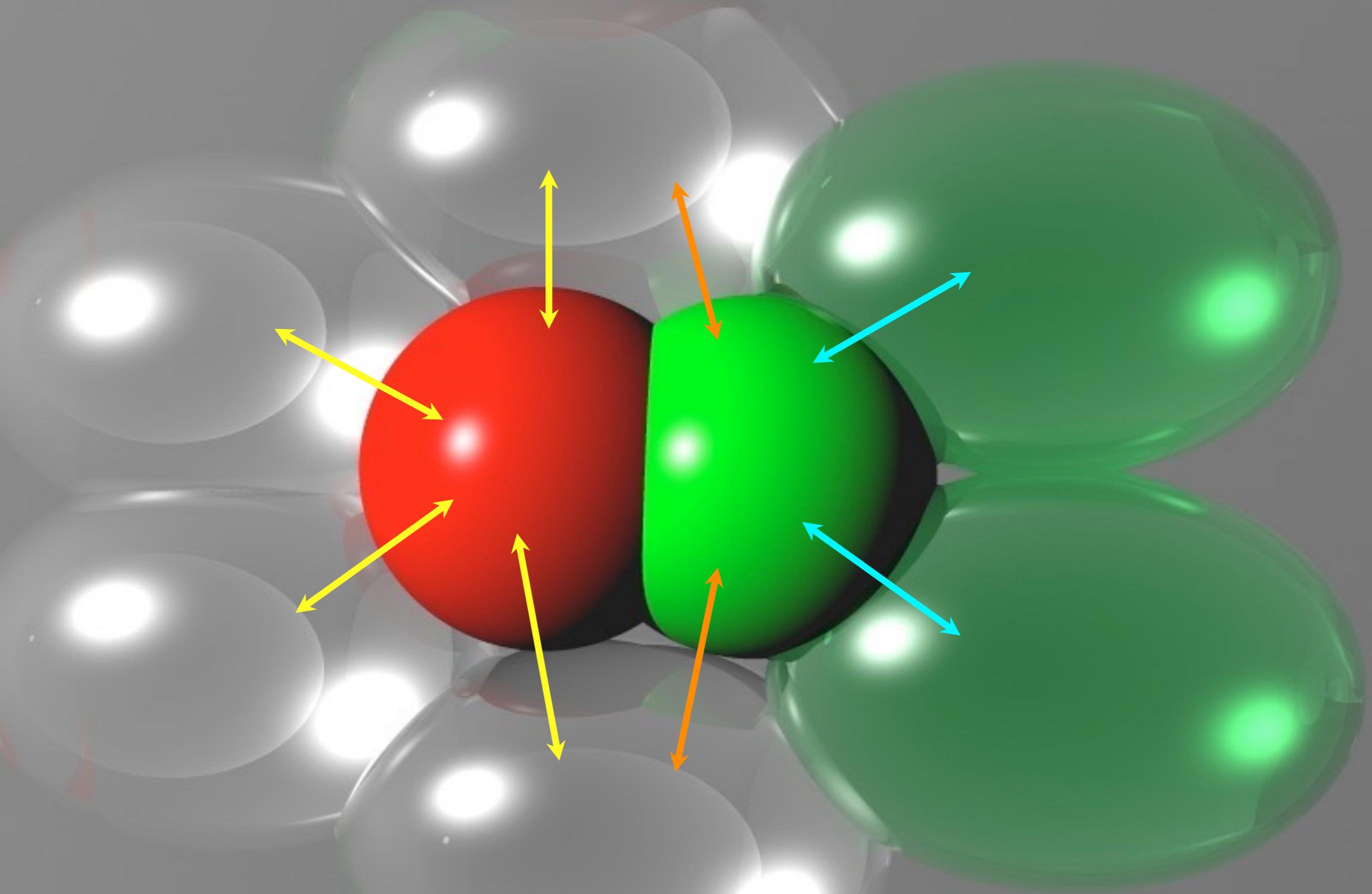
Are plant cell fates controlled by

(1) segregation of determinants?

(2) positional information?

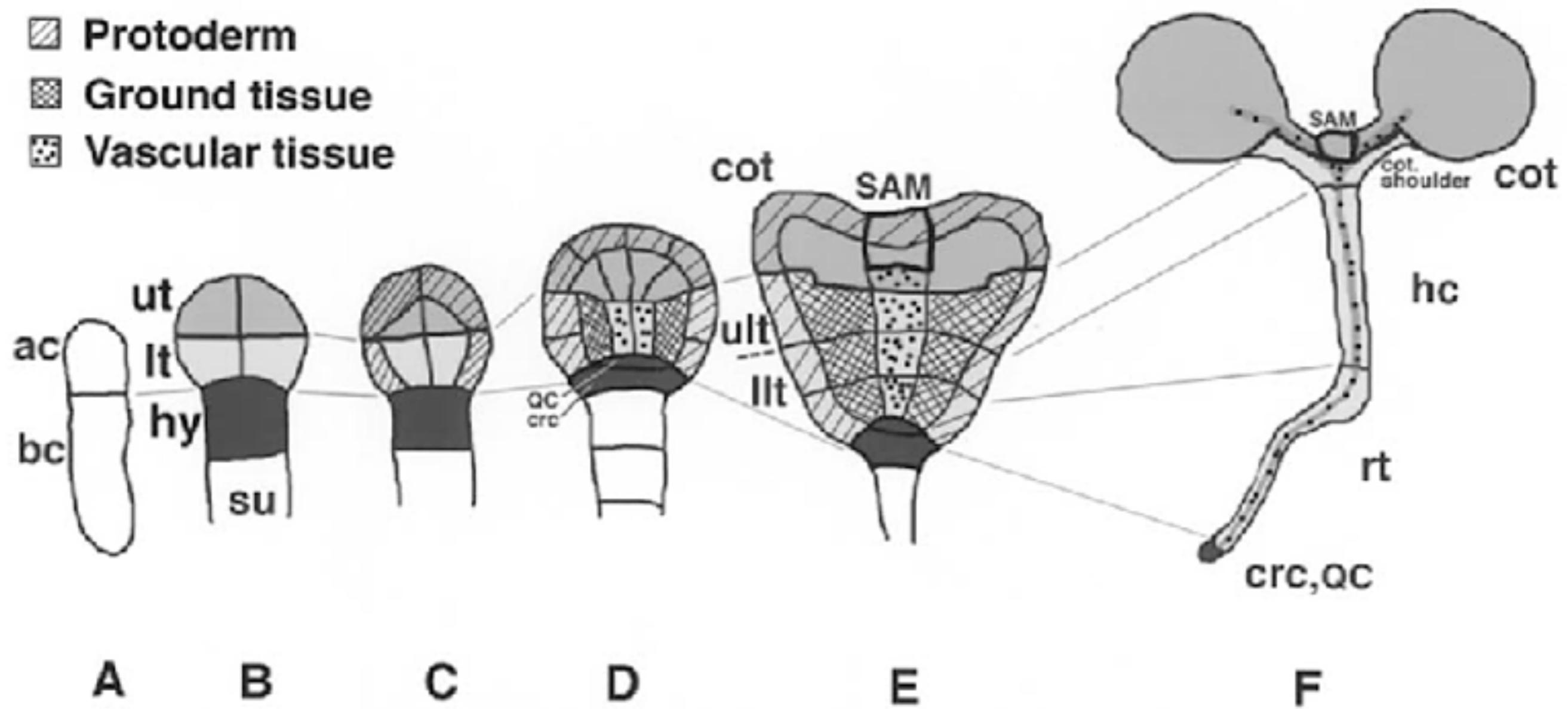


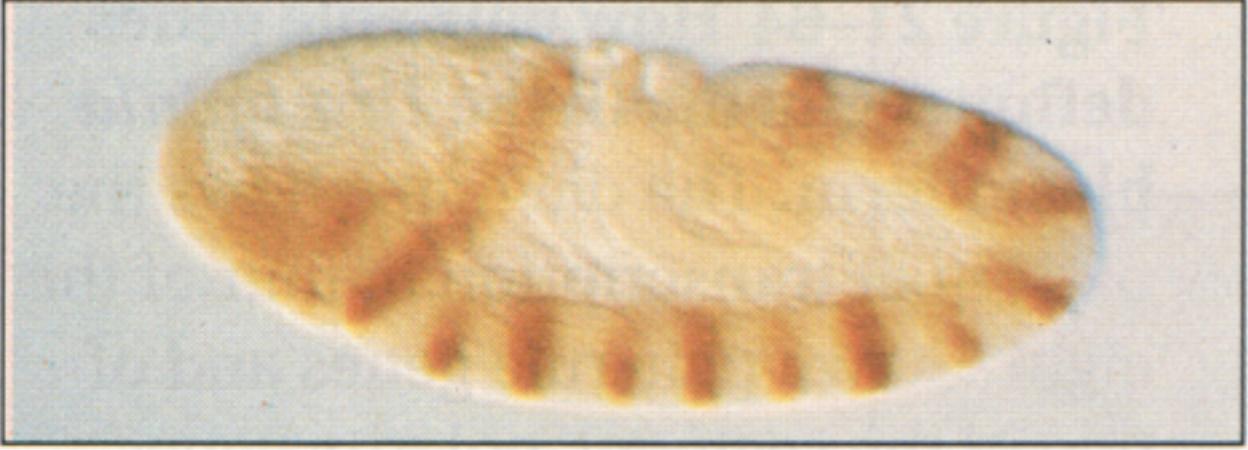




Exchange of positional information

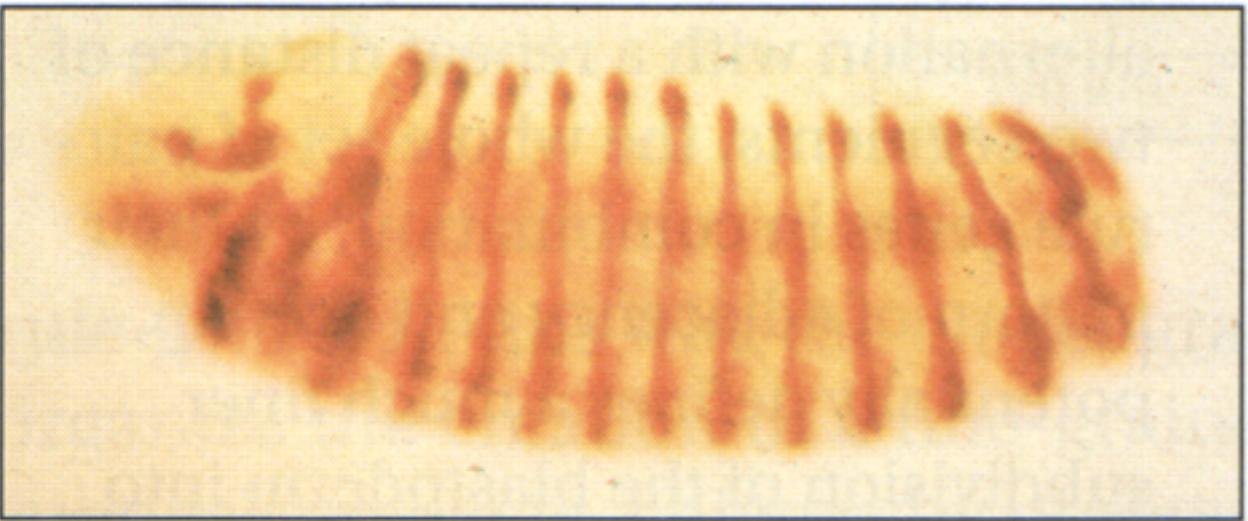
-  **Protoderm**
-  **Ground tissue**
-  **Vascular tissue**





5-hour embryo

100 μm



10-hour embryo

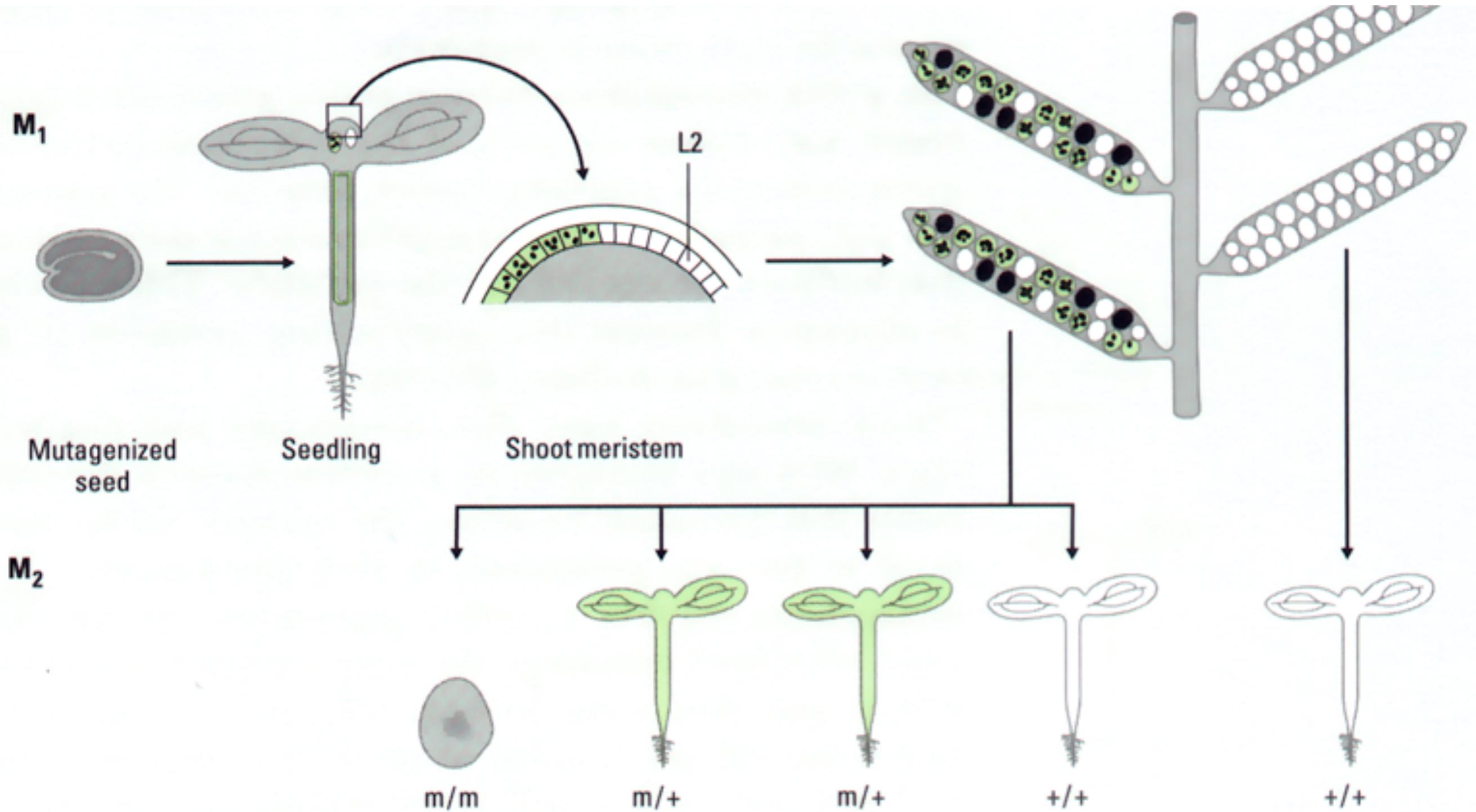
100 μm



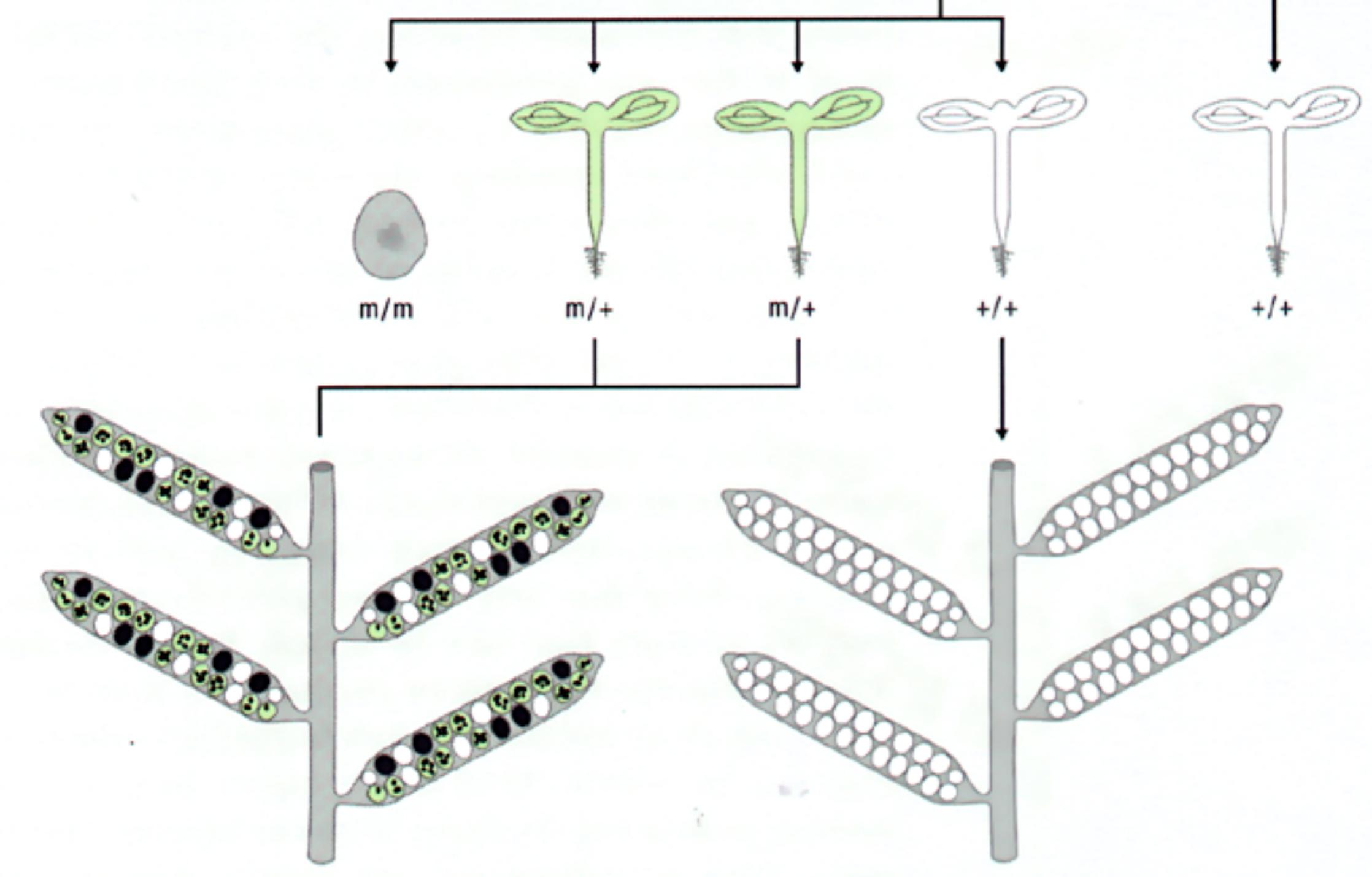
adult

500 μm

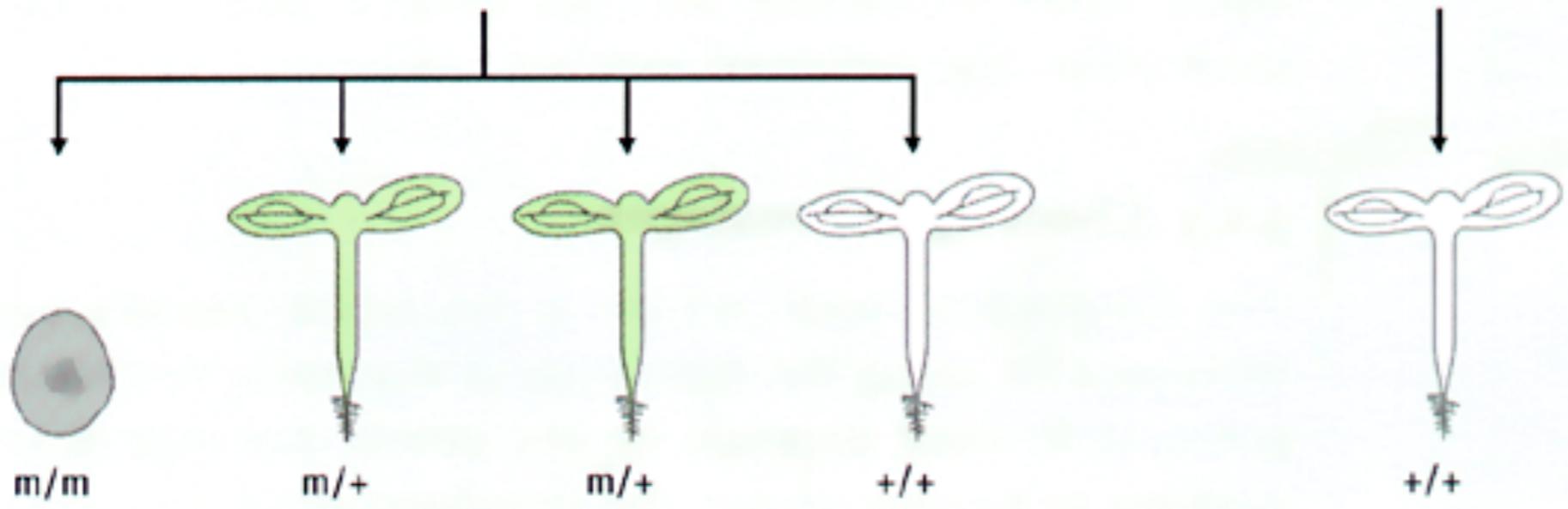
Genetic screening for mutants in Arabidopsis development

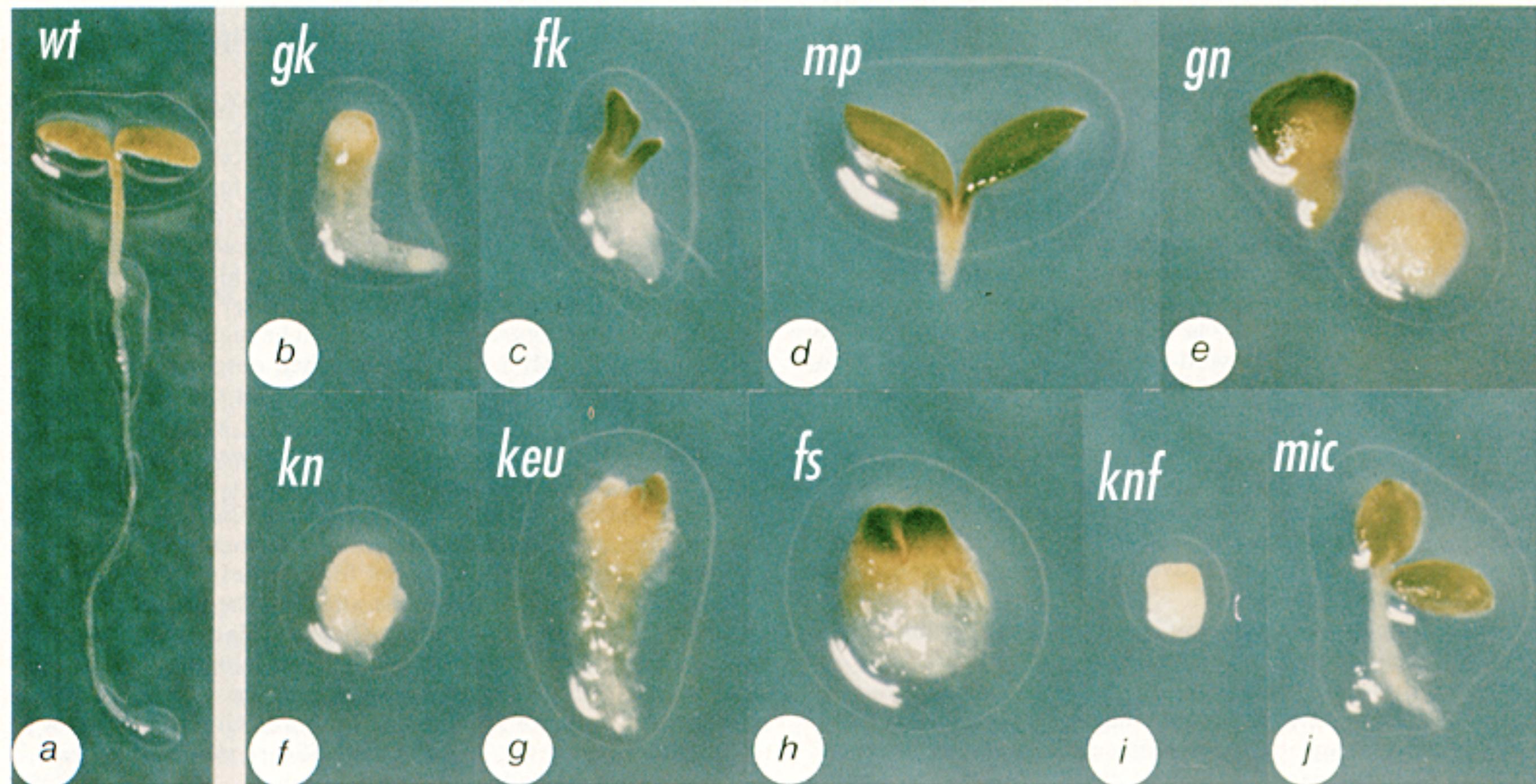


M₂



M₃





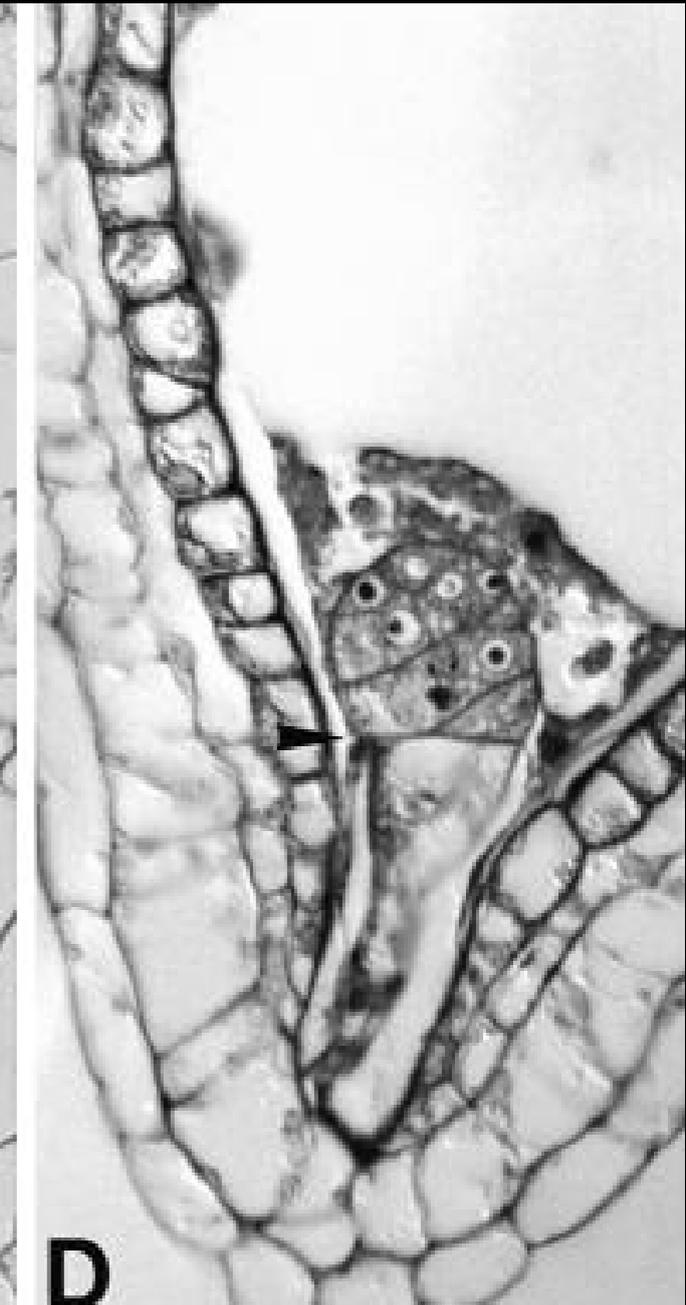
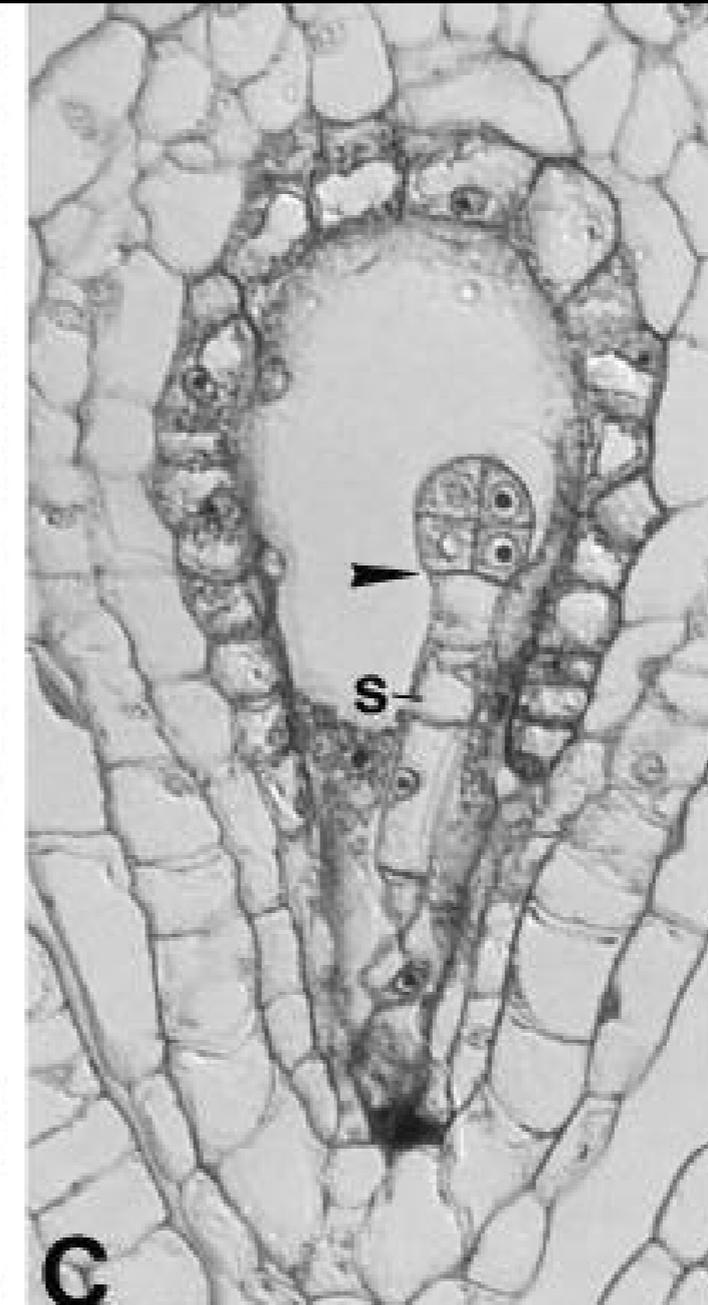
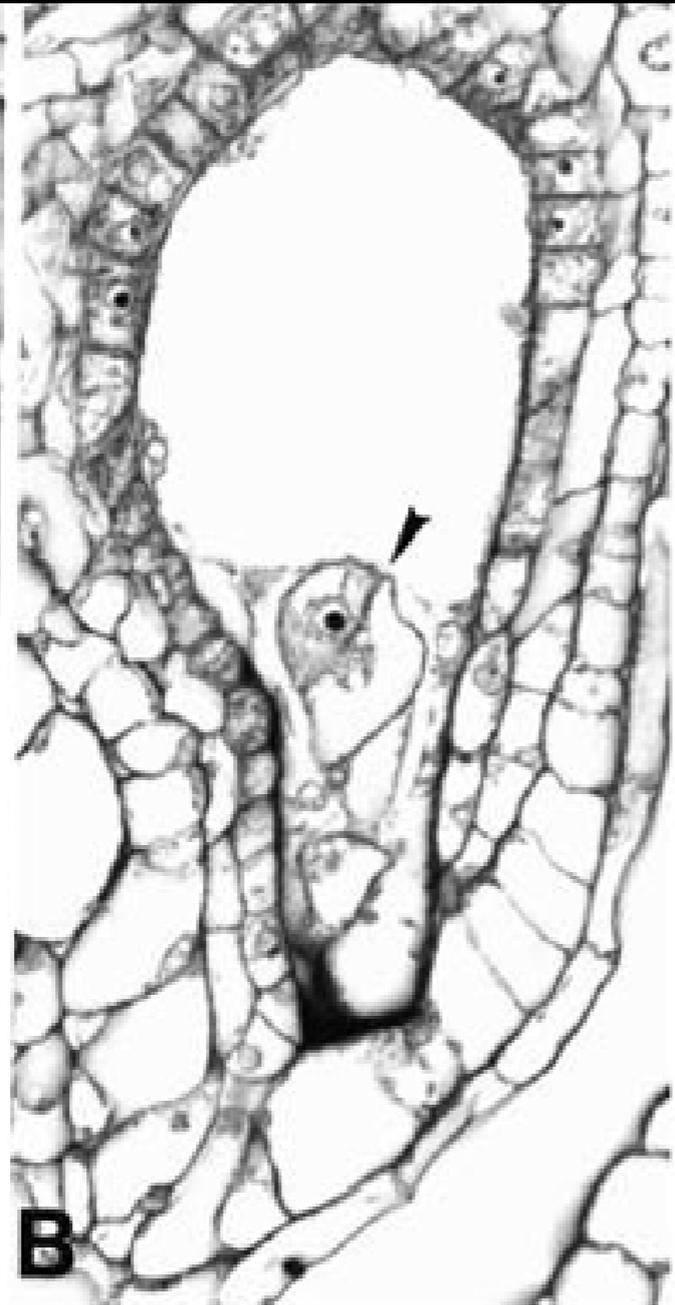
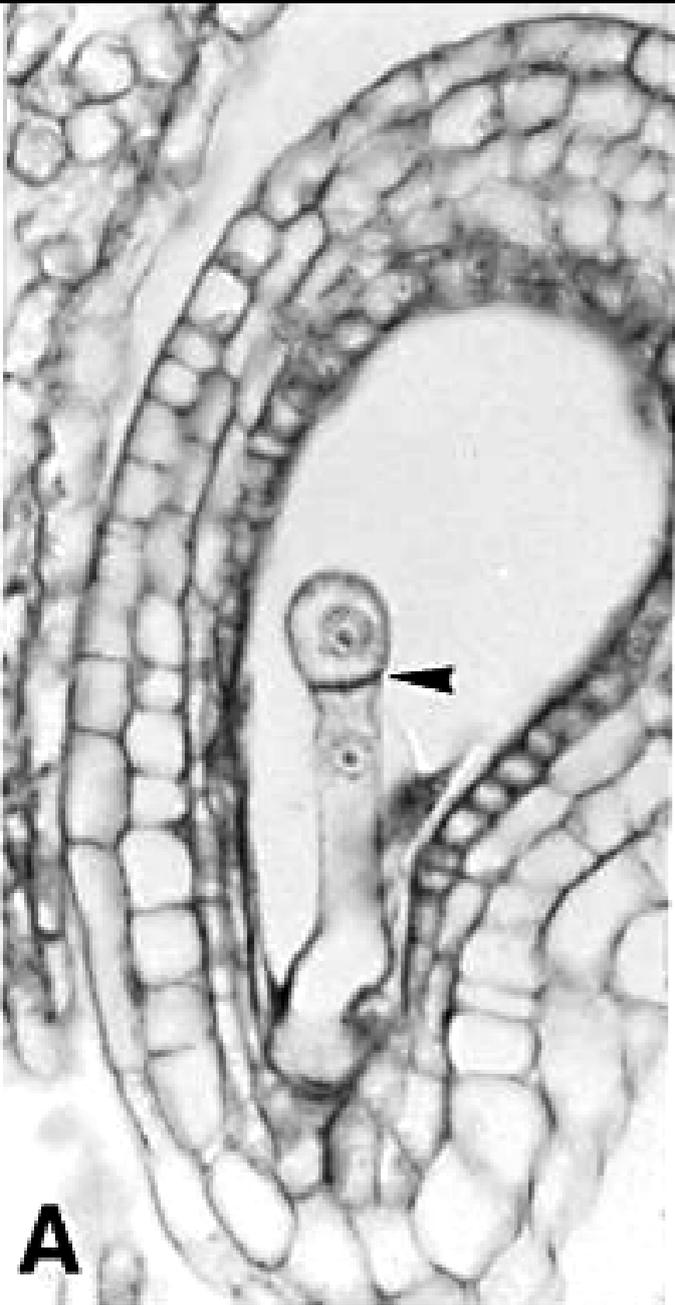
fass mutants have cytoskeletal defects, with altered patterns of cell division

WT

fass

WT

fass



2-cell stage

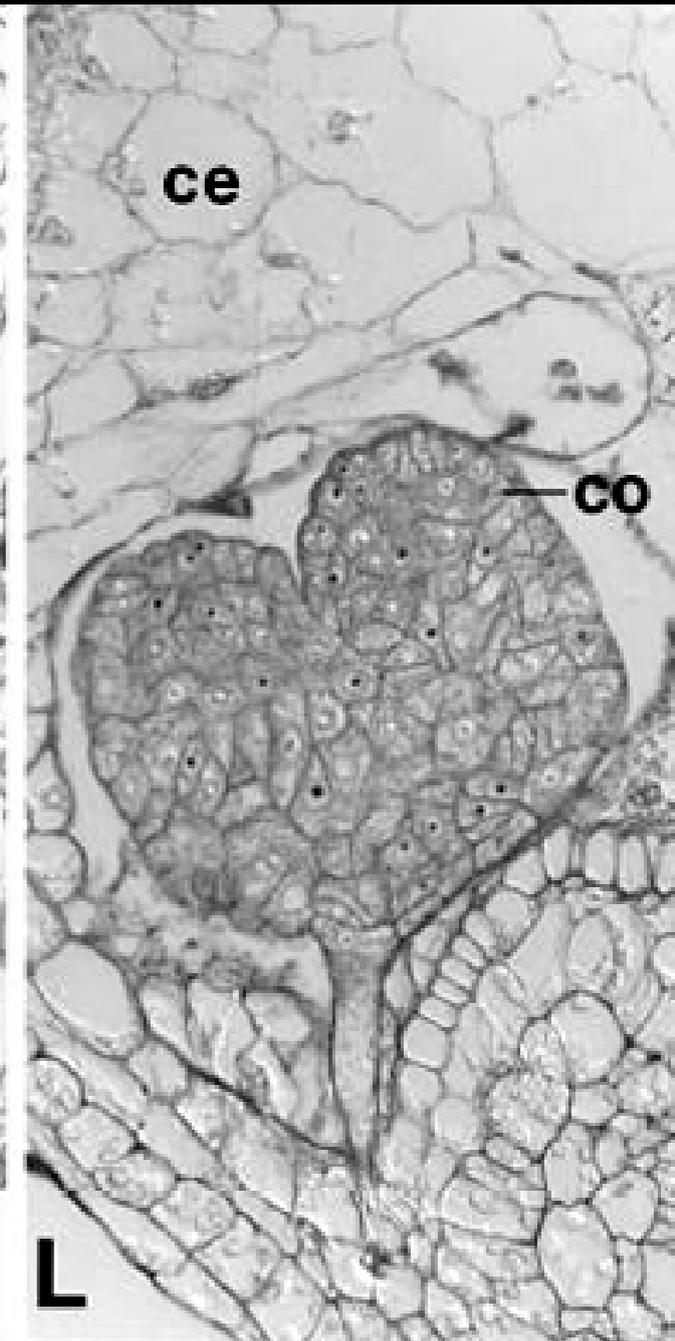
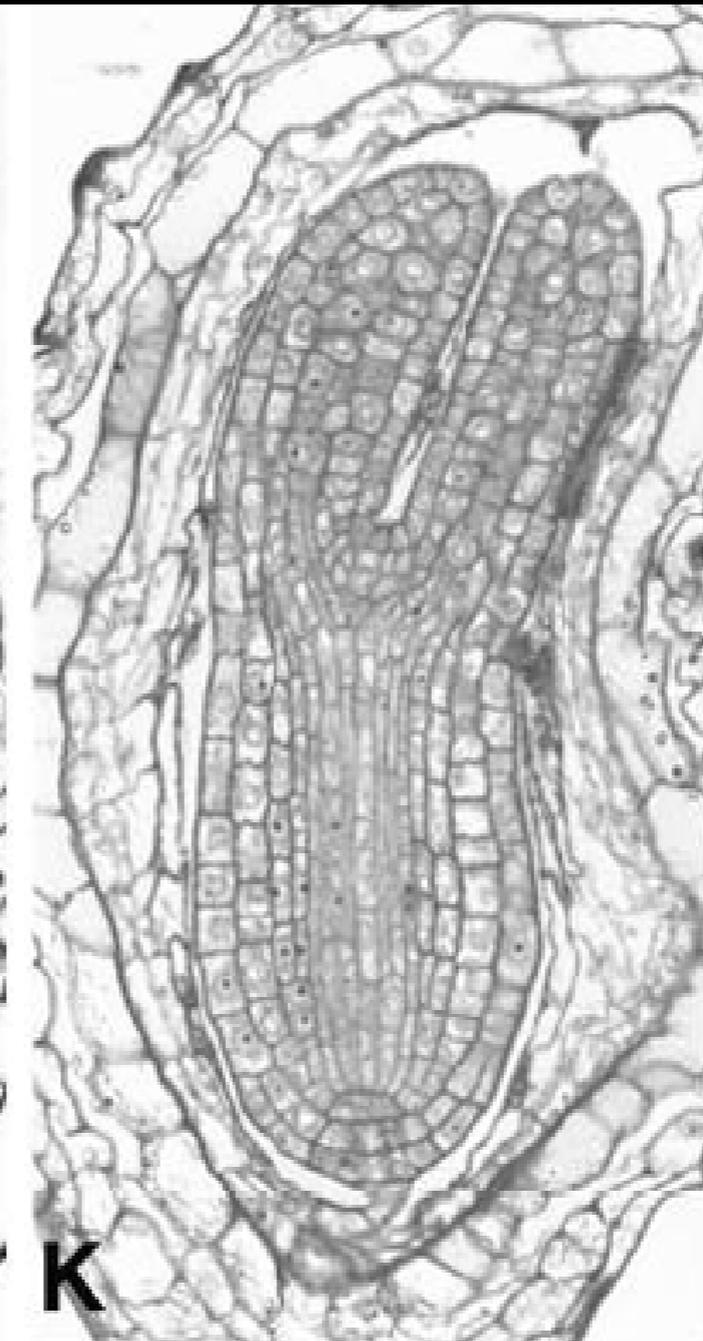
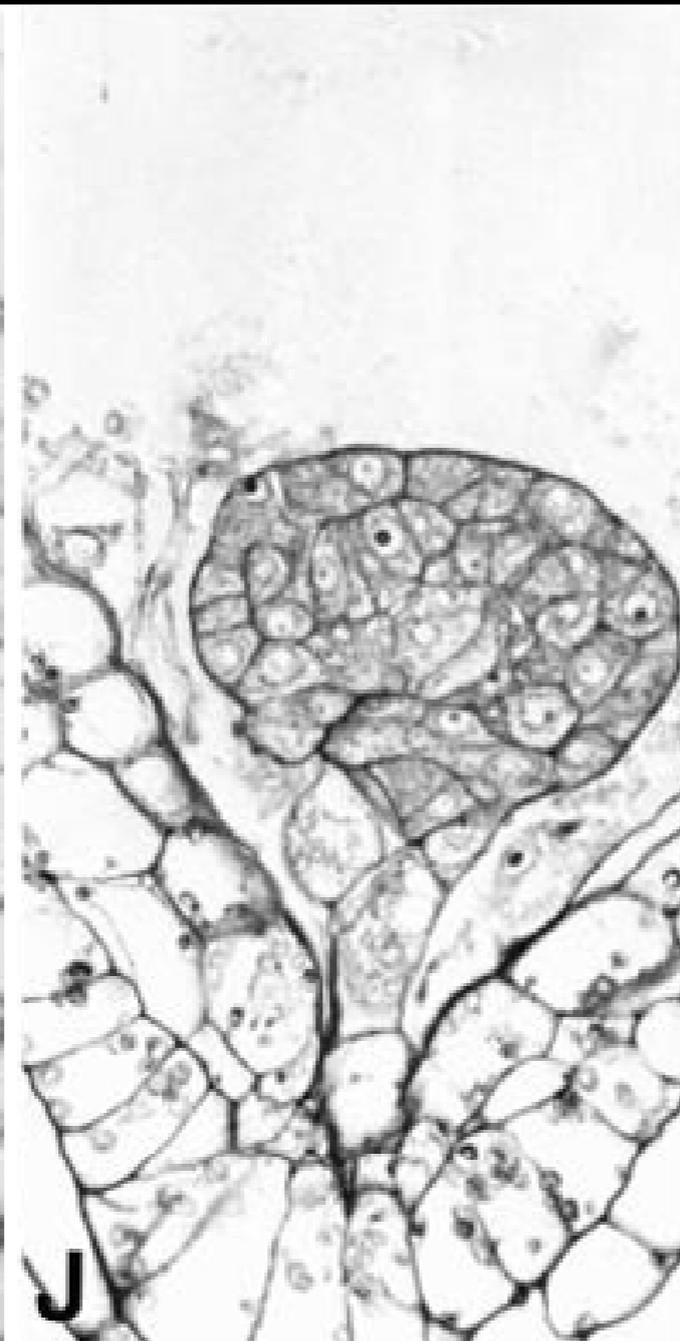
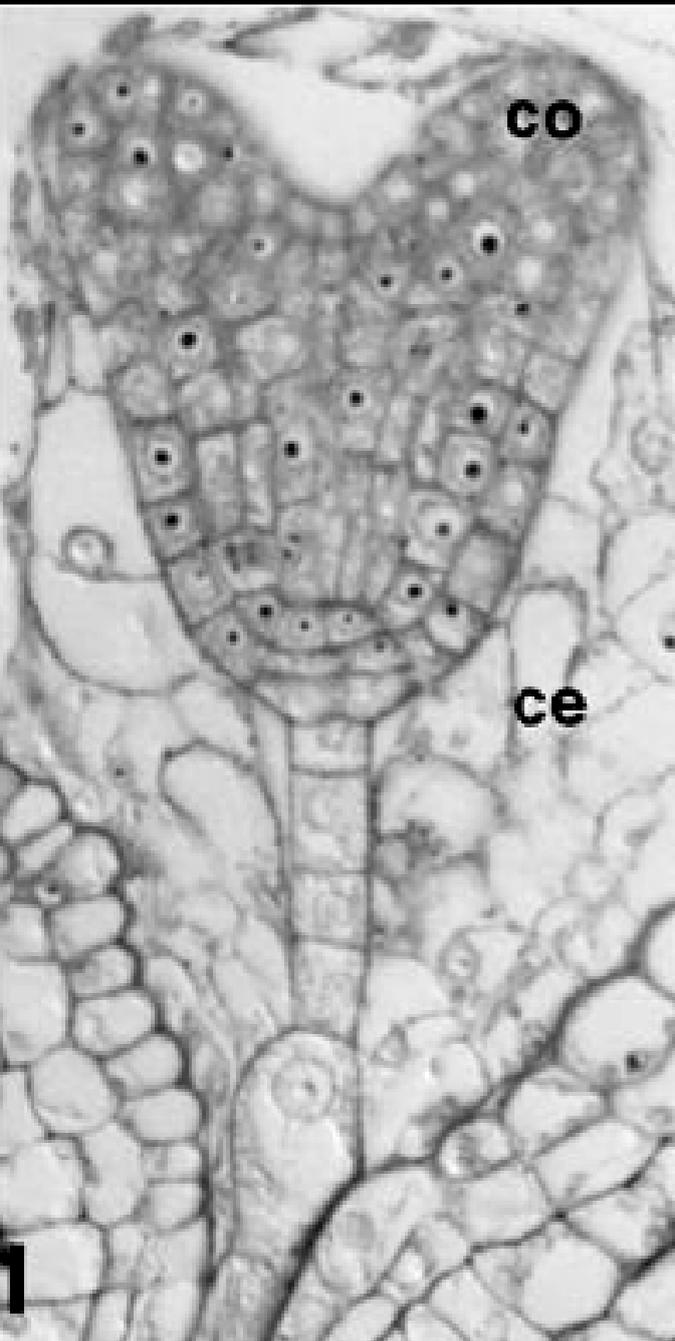
octant stage

WT

fass

WT

fass

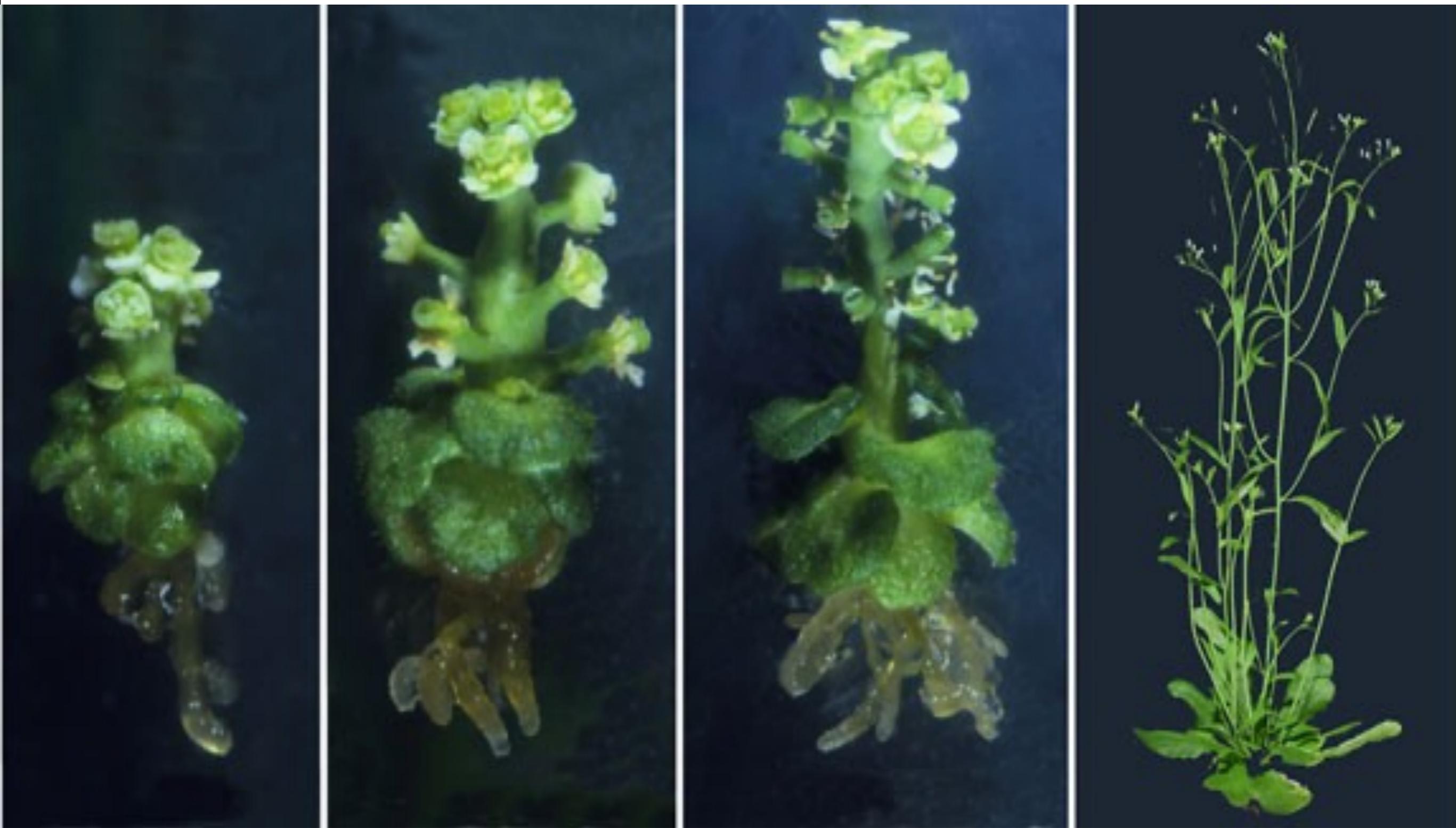


heart stage

torpedo stage

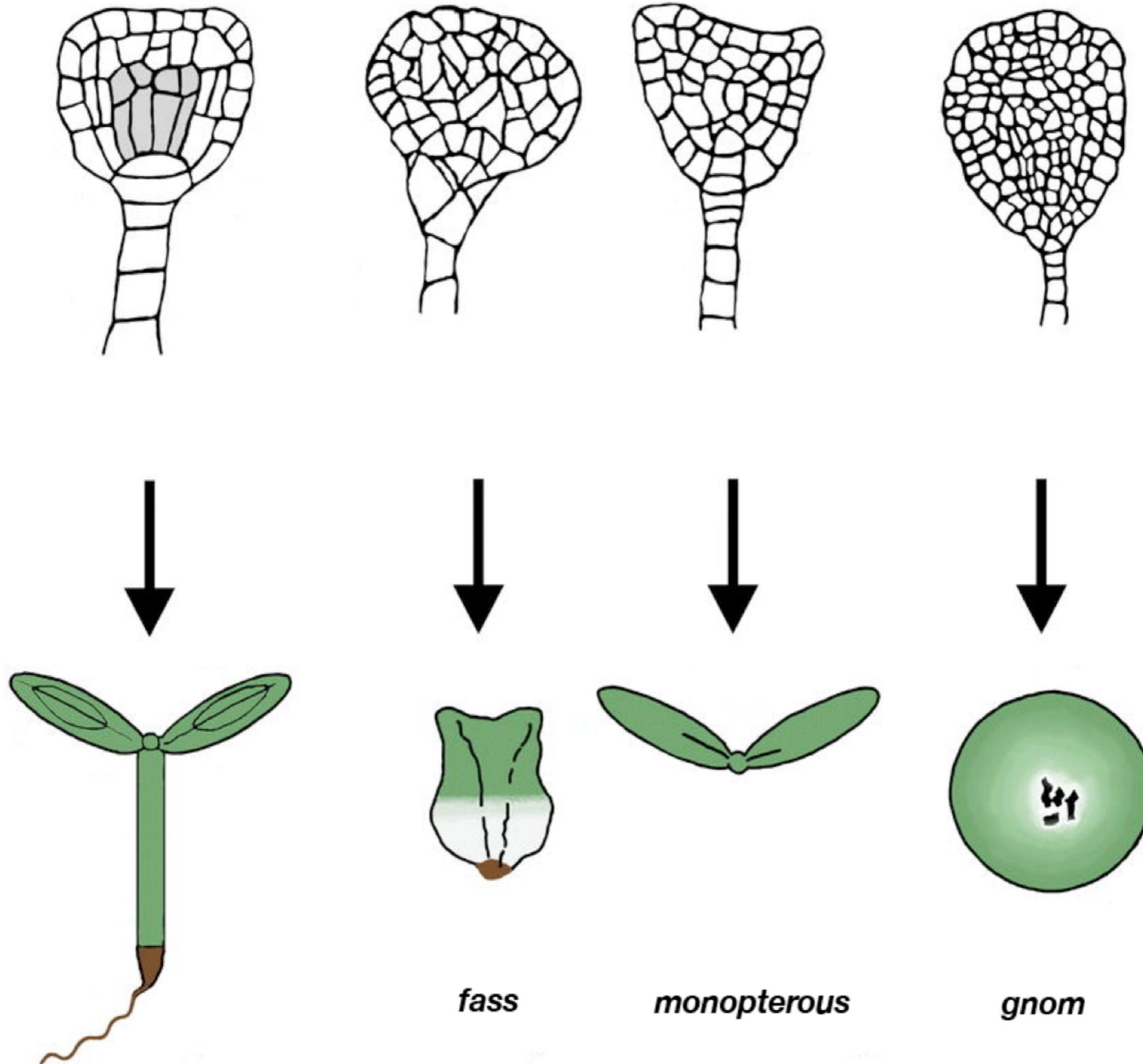
fass alleles

Wild type



fass plants form organised tissues despite deranged cell divisions

Mutations that affect auxin traffic or perception give rise to plants with altered body plans



Production
of auxin

